Agricultural Technology Transfer and Its Consequences

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Preface

The Afro-Asian Rural Development Organization (AARDO), formed in 1962, is an autonomous inter-governmental organization comprising 27 members from Africa and Asia. AARDO is devoted to developing understanding among members for a better appreciation of each other's problems and to collectively explore opportunities for coordination of efforts for promoting the welfare of rural people and eradicating thirst, hunger, illiteracy, disease and poverty among them.

Modern agricultural technology introduced in the 1960s has been instrumental in significant growth of Afro-Asian agriculture in recent years. The success was brought about mainly by the efficient combination of high-yielding varieties, and investments in irrigation, fertilizers, and other inputs. This new technology, which resulted in increased yields and reduced unit costs, has become a cornerstone in the overall strategy of promoting agricultural growth in many developing countries. Facing the need to solve the food problems for the ever-increasing population of the world, technology-transfer methodologies are important to rural development. With impacts of free trade under WTO agreements, production and marketing by the agricultural industry are facing even more difficult days to come. With this situation, applicable strategies should be developed to solve the worsening problems being encountered. It is therefore becoming important to know how to develop new technologies, how to adopt the developed technologies, and how to transfer the newly developed technologies to farmers for rural agricultural development.

In order to research these issues, AARDO took the initiative to collaborate with the government of the ROC on Taiwan to organize the International Workshop on Agricultural Technology Transfer and Its Consequences. This AARDO International Workshop on "The Technology Transfer and Its Consequences" held in Taiwan, ROC was one of the important activities of AARDO this year. AARDO provided travel expense for participants, while the ROC provided other expenses. The workshop was sponsored by the Council of Agriculture (COA) of the ROC and the Food & Fertilizer Technology Center (FFTC). It was co-organized by the Agricultural Research Institute (ARI) and the Chinese Sustainable Agriculture Association (CSAA). The workshop was held from August 25 to 30, 2003 at the Agricultural Research Institute in Taichung. More than 40 scientists and workers attended the workshop, which included seven distinguished invited speakers (two from abroad, one from AVRDC, and four from local organizations/institutes), 23 delegates from 12 AARDO member countries including the ROC, and five AARDO officials.

The workshop focused sufficiently on these and other related issues having bearing on agricultural technology transfer and its consequences. It emphasized that delegates from Afro-Asian countries should share the research consequences and experiences of agricultural technology transfer presented at the workshop. The technical papers and country reports were made during the 3-day scientific sessions; while 2 days were devoted to field trips. The proceedings contain expert papers as well as country statements presented in the seminar which focused on the following objectives: (1) to identify areas of technologies that could be transferred; (2) to highlight the neglected issues of technological changes related to rural development; (3) to devise mechanisms involved in the transfer of technologies; (4) to identify technology transfer methodologies and their importance for rural development; and (5) to identify problem areas in transferring technologies in relation to rural agricultural development. In addition, this book covers all of the above events. It is believed that these proceedings should be of value to agricultural scientists of various disciplines.

I would like to take this opportunity to express our gratitude to all participants who made the workshop a success. Special thanks go to all authors for their diligent efforts in promptly preparing their manuscripts. The workshop and proceedings would not have been possible without the financial support from the AARDO and COA of the ROC and the superior assistance from the staff members of the Agricultural Research Institute.

Chien-Yih Lin, Ph.D.

Director General
Agricultural Research Institute
Council of Agriculture, ROC

Opening Ceremony

Welcome address

Dr. Chien-Yih Lin

Director General

Agricultural Research Institute

Council of Agriculture, Executive Yuan, ROC

Dr. Bahar Munip, Secretary General of AARDO, Mr. Wang, Director General, of the Council of Agriculture, distinguished speakers, honorable guests, dear participants, ladies and gentlemen:

It is the great honor of Agricultural Research Institute to be the host of this very important and meaningful ARRDO workshop. On behalf of the Institute and all the staff members, I would like to extend my cordial welcome to all the speakers, participants, and guests, especially those coming far from other countries.

We all agree that agriculture plays a vital role in the evolutionary process of human civilization and economic growth. However, with the rapid social and industrial development, agricultural production, as well as farmers, is facing the severest challenge we have never encountered before. It has been proposed during the past twenty years that the introduction of new idea and technology is essential to the continuous growth of agriculture anywhere in the world. In Taiwan, although we have enjoyed the success in agricultural development for quite a long time, we, too, aware the problems and difficulties that we are going to meet. In fact, new agricultural technology has been continuously developed by our scientists and transferred to the farmers; for example, the development of new crop varieties with higher yield or quality, new cultural practices involving proper soil improvement and the management of diseases and insect pests. More recently, outcomes from researches in biotechnology have also been transferred to farmers to strengthen their competitive potential with the foreign imports.

However, we must admit that there is always a gap between the scientists' research and field implementation at the farmers' side. The situation might not be the same in different countries; but it is generally agreed that factors such as technical feasibility, economic profitability, social acceptability, and environmental sustainability should be considered as a whole. In other words, scientists, economists, farmers, as well as governmental and private sectors, should be brought together in the efforts of promoting the transfer of agricultural technology.

pages within. The cover should be attractive, colorful, and impelling. The audience should feel an urge to look inside. A bulletin that never reaches the correct hands cannot possibly reach the brain where judgments and decisions are made.

Method 1: Newspapers

Newspapers vary greatly in their audiences and coverage, from large urban daily newspapers to small community papers. They are published by governmental, private, and other organizations (sometimes including extension services) and can provide valuable channels for extension news.

How can one get news accepted and used by newspapers? Mainly by knowing what editors want and by being able to judge the news-worthiness of your information. Here are six ingredients that newspaper editors often use to determine what they print and how they use it.

(1) **Timeliness:** The more timely the information, the greater its news value is.

(2) **Nearness:** The closer the information seems to readers (geographically and psychologically), the greater its news value is. That is, local newspapers prefer local news.

(3) **Consequences:** The more those readers are affected by the information, the greater its news value is.

(4) **Prominence:** Prominent people, places, and things possess greater news value.

(5) **Human interest:** Readers are attracted to human-interest topics such as unusualness, conflict, progress, emotions, and others.

(6) **Newspaper policy:** Newspapers have editorial policies that influence the kinds and amounts of information they publish. So the use of various kinds of extension information may vary from paper to paper or by period, based on editorial policies.

Here are some of the main kinds of articles that extension workers can submit to newspapers.

(1) **Advance articles on an event**: These include announcements of approaching extension meetings, tours, speeches, or other extension events. Such articles are often brief, but should include details that would permit a reader to attend if interested, i.e., the date, starting time, location, sponsor, and nature of the event, as well as the agenda and possibly the name of a contact person who can answer further questions.

(2) **Follow-up articles on an event:** These reports to readers about recent meetings, tours, speeches, or other extension events. Their main purpose is to report results, so they are often longer than advance articles on an event. They should include the date, location, sponsor, and nature of the event, to provide a background for the reader, but the greatest emphasis should be placed upon the outcome of the

specific event. For example, an article about a speech should report what the speaker said. An article about a field tour should summarize what the participants saw and heard. An article about a business meeting should summarize the decisions that were made.

(3) **Information articles:** These are widely used in extension work to provide helpful information of various kinds, such as timely advice, "how-to" descriptions, reports of research findings, market news, relevant statistics, etc. They might not be directly tied to an event.

(4) **Feature articles:** These are informational and sometimes involve news, but they are distinct in several ways from the types of articles mentioned earlier. Feature articles often interpret the news and provide background for readers. Often they are intended to entertain or inspire as much as to inform. They may feature ideas, places, techniques, persons, organizations, goals, successes, challenges, and almost any other aspect of human activity. They often involve more human interest contents than do news or information articles.

(5) **News-writing style and format:** News-writing styles differ throughout the world, so the best approach is to use the styles and formats that local news editors prefer. Work closely with local editors to learn their style rules, deadlines, and other preferences.

Regardless of specific requirements, editors probably want news copy that is neat, readable, and well-spaced on the page. They probably prefer writing that is clear, simple, active, and concise, because such writing permits easy reading, which is your primary goal. They also want copy that is accurate. One of your most successful techniques may be to keep the readers in your mind as you write.

Method 2: Wall newspapers

Wall newspapers are used successfully by extension services in many countries. The wall newspaper is known for being a pictorial, using drawings and/or photographs, with a text as brief and vivid as possible. It is similar in size and appearance to a poster, but often contains more written material and a wider variety of information. For example, a typical extension wall newspaper might use pictures and text to (1) announce the appointment of a new livestock specialist, (2) give a progress report on a current fertilizer campaign, (3) urge the use of vaccine to prevent fowl cholera in poultry flocks, or (4) report on results of experiments with new grain varieties.

In most countries where wall newspapers are used in extension programs, they are produced in quantity by a central office and distributed by mail or through the extension organization. Some wall newspapers are printed by letterpress or offset methods, but

methods such as silkscreen printing also work. Distribution varies according to the requirements of each country. Mailings may be made directly to village leaders, schoolteachers, religious leaders, and others. Sometimes a local extension worker hand-delivers, and even posts or issues the paper. Walls of buildings at busy intersections are excellent posting places. Papers also may be posted effectively on village bulletin boards, in reading centers, in schools, and inside public buildings.

Method 3: Blackboard news

Actually, extension workers need no typesetting or duplicating equipment to reach mass audiences with print news at the local level. Chalk and a blackboard, or a felt-tip pen, or crayon with a newsprint pad, can provide a valuable kind of wall newspaper. In the absence of plain newsprint sheets, extension workers in India have even made hand-printed news in large print over classified advertising pages of discarded newspapers. The classified advertising provides a suitably neutral background for readable, hand-written extension news posted in the village.

Method 4: Newsletters

Newsletters can be an effective, low-cost way to reach readers. The content of a newsletter can be more-localized and specialized than is possible with a general newspaper. Like the wall newspaper, the newsletter is well adapted to the use of local languages and dialects. Also, a newsletter can include hand-written, typewritten, or typeset copy. Duplication methods can also greatly vary.

A newsletter usually contains a larger share of text to visuals than does a wall newspaper, but not necessarily. Page size is smaller than for newspapers, so space is often limited and brevity is vital.

In fact, brevity is one of the benefits that readers find attractive about newsletters. Newsletter writers try to get into each subject quickly, and use short sentences and energetic words. The newsletter can more-selectively be directed to a target audience than newspapers. For example, a newsletter might be distributed only to new mothers in a village; content could provide news and advice about feeding and caring for infants. The newsletter can, therefore, be newsy, localized, and specialized in what it covers.

Extension personnel might publish their own newsletter, or newsletters, or they often submit news to newsletters published by other organizations, such as cooperatives, that reach readers with interest in extension services.

Method 5: Folders, leaflets, and pamphlets

Simple folders, leaflets, and pamphlets can be used in many ways in extension programs. They may be used singly, for example to explain the advantages of a soil test. They may be used in a series of broader subjects like swine rising, with separate leaflets on feeding, housing, and breeding. They may be used as reminders of when to plant crops or what chemicals to use to control different insects.

Folders, leaflets, and pamphlets may also be used in coordination with other visual methods in long-range campaigns. Because of their low cost, they can be given away at meetings and fairs, and offered on radio programs. They are useful to supplement larger publications when new information is available and when reprinting of the entire publication is not practical. An experimental campaign is being conducted in the Northwest Frontier Province of Pakistan by dropping timely one-page leaflets which discuss insect pests and vegetable growing practices from spray planes in village areas.

In addition to the advantages of low costs and short preparation times, folders, leaflets, and pamphlets take less time to get their message across. Their smaller size makes it necessary for the author to eliminate non-essentials from the message.

Method 6: Fact sheets

Fact sheets are "boiled-down" treatments of subject matter. They usually cover a single topic, and often they are limited to a single page. Most fact sheets are illustrated with drawings, photographs, or both. The illustrations are used to show details or steps in a process, to make the information clearer and more understandable. One of the important uses for fact sheets is to provide current subject matter to field workers. Field workers often complain that needed technical information is slow in reaching them. Much agricultural information is carried in technical bulletins and other lengthy publications. These take considerable time to process and distribute.

On the other hand, the essential facts can be written down and combined with drawings and/or photographs to make an effective summary that can be reproduced quickly and inexpensively in the form of a fact sheet. This puts current information into the hands of local extension workers, providing better service to farm families. Extension administrators who are concerned with the problem of speeding up intra-staff communication of subject matter should study the advantages offered by fact sheets.

B. Audiovisual media

The communication methods that rely on the audio or visual senses, either alone or in combination, help overcome the barrier of illiteracy and offer special advantages. The most

common forms of integrated audiovisual media are televisions and computers with a speaker, while simple audio media include radios and cassette tape recorders/players.

Method 1: Radio

Radio can be one of the most useful mass communication tools for extension workers, for several reasons. It offers immediacy, as radio programming can be changed quickly to meet new conditions. It reaches large numbers of people, especially as transistor radios become more widely used. It permits listeners to take their radios wherever they go, even where electrical power is not available. Radio provides the warmth of the human voice. It can tie into strong oral traditions of communities and overcome literacy barriers that face print media.

Extension workers find that radio works most successfully at the local level, to communicate local problems, solutions, and activities. They use local names, voices, and activities in programming. Farmer success stories and other kinds of neighbor-teach-neighbor approaches have been found to work well. Radio is most effective at the awareness and interest stages of the adoption process.

However, listeners cannot refer back to what they have heard on the radio, nor can they see what is being described. So radio is limited in its ability to convey detailed, complex information and, used alone, is limited as a teaching method. Also, televisions and computers are rapidly replacing radios as a better audiovisual communication means with the increasing economic wealth of the developing and developed world.

Two types of broadcast radio are commonly used for extension programs.

(1) **Open broadcasts:** Extension workers provide programs for the station's broadcasts, such as spot announcements to be taped and repeated at intervals throughout the day, or longer programs, presented in person or taped for use on scheduled programs. Stations also invite printed news releases that can be read in newscasts and other programs.

(2) **Group-listening to open broadcasts:** Extension services in many countries use approaches commonly called listening clubs, radio schools, or farm forums.

Local participants gather at a certain time, listen to a program broadcast by a certain station, and then discuss the program in terms of their own situations. Organized group listening can produce good results because it more closely involves listeners than individual listening does. However, listening groups are difficult to maintain and may require more of the extension worker's time than can be justified. Instead of organizing an extension listening group, it may be possible to promote collective listening in existing groups, such as cooperatives or farmer's associations. If an extension office wishes to organize its own group,

it might be created for a limited period, perhaps keyed to a timely topic that is important to local listeners. When the series of broadcasts ends, the group disbands.

In general, group listening declines as transistor radios become more widely used by individuals and families. In some communities, participants in a radio group listen individually to the specified broadcast, and then discuss the program at a later meeting. As radio ownership grows in local communities, it seems likely that extension workers will use listening groups mainly for major topics that can arouse widespread local interest.

Here are some tips for preparing and presenting radio programs for broadcast.

(1) Try to localize the content and match it to the interests of listeners. Emphasize local matters and involve local people.
(2) Take advantage of the timeliness of radio by emphasizing current activities, trends, issues, developments, and so on.
(3) Use sounds in creative ways. The voice is one kind of sound, but you can use many other kinds effectively.
(4) Attract the listener's attention quickly, through a compelling remark, catchy introductory sound, or other technique. The first 10 seconds of a program are especially important.
(5) Give information in a flowing manner that makes it personal and easy to follow. Good radio copy is written for the ear and uses simple, understandable words. Test your radio copy by reading it aloud and revising it until it reads easily and flows smoothly.
(6) Speak in a normal conversational voice, at a natural speed. Speak as if you were conversing with one person. Sound interested.
(7) Use changes of pace in your presentation to hold interest. You can do so by varying your reading speed, for example, or by varying the kinds and volumes of sound.
(8) Repeat important facts, such as dates, times and places of meetings. Listeners cannot refer back, as they can with printed material, so they must rely on you to repeat important information.
(9) Invite listeners to take part. You can involve them mentally by asking questions, posing problems, and otherwise encouraging interaction as if you were in conversation. You can even involve them physically, sometimes, by inviting them to carry out certain actions as you speak.

Method 2: Audiocassette recorders/players

Low-cost, battery-powered cassette recorders permit extension workers to use recorders in some effective new ways. A radio listening group can record its reactions, conclusions, questions, and suggestions about a given program or topic, then send the cassette to the station or sponsoring organization for information and follow-up. A regional or

central extension office can produce and record instructional programs on audiocassettes for use at local levels. Such cassettes might be used in group meetings or made available for individual listening. Local listeners can, in turn, record their own reactions or questions on cassettes, which are returned to the regional or central extension office as valuable feedback. A local extension worker can make field recordings for use in group meetings. The recorded material can add interest to meetings, yet is simple and cheap to produce.

Cassettes can permit multiple use of information aired on broadcasts, by simply recording a program as it is aired. The resulting recorded program can be used later in group meetings. Conversely, the remarks of a guest speaker at a meeting can be recorded, and perhaps used in a later broadcast.

Method 3: Television

Two types of television media are available for teaching purposes. The first and most familiar is broadcast television, in which programs are aired over a large geographical area. The second type is sometimes referred to as closed-circuit television. This usage takes a video signal from a tape or cassette and carries it over a cable to one or more monitors. The monitors may be in several locations or next to the video player.

Broadcast television offers exciting possibilities for extension workers. The agricultural officer can demonstrate as well as talk. He can present useful method demonstrations as well as show a whole series of result demonstrations through pictures, which show changes over time. All types of visual aids such as charts, graphs, live objects, and blackboards can be used to increase teaching effectiveness with television.

However, caution should be exercised before launching into the use of television. Television programs require meticulous preparation. Every piece of equipment must be in place, and the dialogue must be well thought out. Most importantly, study the geographical area that the transmitting station covers. Secondly, determine the number of receivers that are available to the intended audiences. It is useless to program for rural audiences if they do not have the necessary receiving equipment or they live outside the range of the transmitter.

Organization is an essential ingredient of a television program. The method used to arrange the sequence of related words and pictures that make up the story is called a "run down sheet". This sheet is divided into two columns, one headed “video” for pictures, the other for “audio”, which contain an outline of what is to be said. The run down sheet is not a script but an outline to guide the television crew as well as the performers. Start using this medium with programs with all the action in one place. Then test out the ability of extension personnel to perform more-involved sequences as experience is gained.

The basic rules are simple. Move deliberately to allow the camera to follow. Operate

within a small area. Hold any material steadily on target for camera viewing. Avoid the use of complicated demonstration material. Time the presentation before going to the studio to make sure the program fits into the allotted time. Have some extra points ready to present in case the material runs short. Color combinations and light contrasts are important. The television engineer can specify which combinations are the best.

In spite of the relatively high cost of receiving sets, television occupies an increasingly important role in developing countries. Many governments have installed sets in each village so villagers can receive official broadcasts. Extension administrators have only to convince authorities of the value of their educational broadcasts to open up this useful channel of communication and education to the mass of people.

Method 4: Instructional television

Instructional television can be an excellent tool for extension workers. Instructional television is distinguished from broadcast television in that materials are not designed for distribution by the mass approach of broadcasting. Productions need not be tied to specific time constraints of broadcast requirements and can be as specific in length as needed. The medium of instructional television had its beginning in cable television, with programs distributed from a central source to outlets in various centers, such as classrooms or conference rooms. With the advent of new formats of videotape such as 3/4" U-Matic, 1/2" Beta, and 1/2" VHS, the possibilities of using instructional videotapes or television have expanded dramatically. These systems feature color images and can produce programs with lightweight portable equipment powered from battery sources. These videotapes can then be edited in production centers and duplicated to provide current materials for extension leaders and officers. This gives immediacy to a medium for transmitting information in times such as an insect or disease emergency. The ability to prepare timely topics in the field using identifiable farmers as subject matter carries an enormous credibility factor. Videotapes can be stored for use at later dates or erased and reused when the subject matter is no longer timely.

Another value of this medium is as a training tool for extension workers enrolled in "in-service" education courses or refresher courses. Workers can be videotaped in presentation sessions, and the tapes viewed to help individuals evaluate their own delivery styles, their presentation strengths and weaknesses.

Videotapes can be mailed, sent by messenger, or carried by extension personnel to wherever extension audiences may be located. A video-player and a television receiver or monitor is needed for delivery. These units can be powered by batteries, provided the right selections of equipment are made. Viewing stations should preferably have access to main power.

Videotape technology is the most expensive of all of the mass media methods. Users should be aware of this fact and financing and maintenance must be adequately provided for before adopting the technique. Personnel who plan to use the equipment will need to receive adequate training. The basic rules for planning and production of broadcast television also apply to the production of materials for instructional television.

Method 5: Computers

Computer technology is developing at light speed. One of the most useful teaching means using the computers is CAI, which also can be applied to farmers' education on any agricultural subject.

The term "CAI", computer-aided (or assisted) instruction, refers to any use of computers that interacts students in any way in the educational process. The major benefits of CAI are as follows.

(1) CAI allows students to practice procedures as long as required to achieve defined competencies. This helps level the ground where students bring a wide range of native skills and educational backgrounds to a classroom. Students with a strong desire to learn the subject can succeed even with weak backgrounds when given the right learning tools and a supportive environment.

(2) Immediate feedback provided by CAI saves time and prevents learning the "wrong" concepts. In traditional training, students can do a number of problems entirely wrong on a homework assignment. The student would not be aware of his/her misconceptions until the teacher grades the homework. Then, the student has to not only learn the proper procedures but "unlearn" the wrong procedures as well.

(3) With CAI, students can determine their own weaknesses and concentrate efforts on overcoming those weaknesses before moving on to more-advanced concepts.

(4) Good CAI materials reward students immediately for correct responses and behaviors. This encourages students to confidently move on to more-complex concepts. CAI can make learning interesting and exciting.

(5) A small but nevertheless important benefit of good CAI material is the on-line immediate evaluation and grading of a student's work. Very few instructors and professors will miss the hours of mindlessly correcting and scoring student homework. More importantly, this aspect of CAI leaves the instructor more time to work with students on an individual basis. All aspects being considered, CAI does not necessarily replace teachers, textbooks, classrooms, or laboratories. CAI is another aspect of training that harnesses the computer and makes it a tireless participant in the educational process. Perhaps the greatest benefit of CAI is that it can give marginal students that small boost which leads to success.

Typical CAI material is comprised of the following items.

(1) **Tutorials:** Tutorials are self-instructional programs or documents that present lessons on the computer screen in some combination of text and graphics. The quality and effectiveness of tutorials are highly variable. A key element in effectiveness is the level and quality of interactivity required of the learner. Some tutorials appear very attractive on the surface while requiring the learner to do almost nothing.

Pretty graphics and carefully composed text is often developed with the buyer rather than the learner in mind. Students will quickly become bored and lose attention if the interaction required is weak or nonexistent. Some tutorials have interactivity that is limited to right or left arrows that only allow students to turn pages. Good interactivity should be more complex than an occasional multiple-choice question with a fixed answer. Another quality indicator in tutorials is intelligent loops and branches based on learner behavior. Good, highly interactive tutorials are expensive.

Tutorials require reasonable reading comprehension, self-discipline, and long attention spans to succeed.

(2) **Drills and practice:** In subjects that require students to learn many complicated procedures, drill and practice CAI programs can be highly effective. The ability of a computerized program to compose many variants of a problem can be used to expose students to greater variety than is possible using textbooks alone. The immediate correction and grading is, without question, highly motivational to students. When carefully constructed, drill and practice programs can present students with challenges rather than chores. The motivational and learning value of immediately seeing "CORRECT!" appear on the computer screen after working a complex problem is enormous. Drill and practice CAI programs can be used to good advantage to reinforce procedures and processes taught in the classroom/textbook or through a computer-based tutorial. Good drill and practice CAI should use a random generator to create a spectrum of variations of each problem/situation presented to learners to make repeating a lesson worthwhile. To the extent possible, good drill and practice material should measure not only on a correct/incorrect basis but time on task or other meaningful measures of accomplishment.

(3) **Simulations:** Simulation CAI programs can be a very powerful tool for teaching the operation of complex systems. Obtaining an instant answer to a "what if" question can generate interest and a "feel" for how a thing operates not readily possible through physical analysis. Good simulation programs do have a learning curve.

Student must spend some time learning to operate and interact with simulation programs which are often not as intuitive as tutorial programs and drill and practice

There is no doubt of the importance and subsequent influences of this workshop. I hope that the results of research findings presented at this workshop will be thoroughly discussed and later utilized. I also hope that this workshop will promote the information exchange among policy-makers, scientists, and farmers to accelerate future research, education, and extension activities in the related areas. As the organizer of this workshop, I foresee the very success of this workshop. To our foreign participants and friends, I wish that your stay in this country will be very pleasant and rewarding.

Lastly, I wish all of you good health and success in whatever you are wishing for. Thank you very much.

programs. Simulation programs generally combine systems design and training tools. Therefore, a supervisor must design activities into his/her course situations and involve the simulation program in a useful instructional fashion.

A few CAI programs combine simulation with drill and practice to produce easy-to-use virtual reality that can be measured, tested, and repaired on the computer screen. The choice of CAI software by a specific training program depends on many factors beyond the analysis of general benefits and projected positive outcomes. The instructor's teaching style and opinions must be taken into consideration when possible. Instructors rarely use instructional materials unless they personally feel that the material has educational merit. A teacher who believes strongly in the value of a training aid, CAI or otherwise, will tend to work vigorously to obtain good results from the material. Student opinions often reflect teacher assessments of the value of instructional aids, CAI or otherwise. Cost is also a driving force in many instances. The cost of adding CAI to a training program can be as little as a few dollars per student, or up to $10,000 or more per training station. The less-expensive CAI materials are supplemental training software programs that reinforce the existing classroom/textbook/laboratory training.

Another form utilizing computers in education is Internet technology. As the information age opens up with splendid development of related technologies and economic affluence develops such that many can afford high-technology systems, the Internet through computers has changed life. Few people 20 years ago could have foreseen the possibility that online training would remove extension workers from having close contact with farmers. Nor did many people 20 years ago think that e-mail might one day serve as a substitute for long-distance phone calls. A complete overview of what the Internet has to offer education is beyond the scope of this overview. The Internet holds endless possibilities for economic reforms, capitalized learning environments, and current, more-accessible information than we could possibly hope to attain within the confines of traditional education. The combining of cultures and societies from around the globe, due to communication via the Internet, offers exciting possibilities for greater problem solving and reinventing the way that we teach and learn.

With these benefits of the Internet, we can further explore some of the trends in technological education. In the 21st century, students and teachers will prefer "on-demand", virtual learning to traditional school programs. This trend will influence the way information is transferred, as well as how information is retained. More-interactive lessons and greater learner input will personalize and internalize knowledge better, through kinesthetic, audio, and visual involvement. Books generally take from 3 to 5 years to print and publish before readers receive them. In the future, many books and useful information will be online, on

compact disks or digital video disks, allowing information to be more current and more easily updated with greater cost efficiency.

Virtual education will accelerate learning through interactive multimedia resources, networking via the Internet, interactive television, satellites, and other technologies. These media will dominate the preferences of the masses. The Internet will enable students to take a greater interest in developing the way they learn best. The most-informal learning experiences on the Internet are just as valid as formal courses. These can be serendipitous findings or accidental learning. Some of the best learning experiences have been the result of linking to a web site through hypertext navigation, surfing, or succumbing to the temptation provided when a search retrieves seemingly unrelated results. To succeed as an online facilitator, one has to possess certain skills, knowledge, and competencies.

Most importantly, he/she should know how to use conferencing software and how to facilitate the learning process in an online environment. Online facilitation can have different meanings. At some sites, the term means asynchronous communication such as discussion forums, electronic bulletin boards (BBSs), and e-groups. Online facilitators for electronic bulletin boards and forums act as moderators reviewing contributors' messages offline and posting administrative messages. Online facilitators of synchronous events work in real time often dealing with technical problems, while keeping a discussion moving in the right direction and at the right pace.

Regardless of the mode of delivery, an online facilitator of resources needs to focus on the following three main topics.

(1) **Role of the online facilitator:** The Australian National Training Authority (ANTA) compared the role of the online facilitator with the role of a teacher, as "online facilitation changes the role of the teacher – from that of information provider and teacher to that of a coach, an orchestrator of resources and a leader and guide in the learning process". Although online course facilitators and teachers alike play a variety of roles, facilitators using the online medium can divide roles among several people. This is certainly the case with conferencing software. Having someone to deal with technical problems behind the scenes allows the facilitator to concentrate on his role as coach, leader, or guide.

(2) **Online facilitator skills and competencies:** According to ANTA's *Conceptual Model of Influences on Online Teaching and Learning*, the competencies required of online facilitators to ensure an effective online learning environment include the following aspects. (a) Instructional: questioning, supporting, leading and pacing, and providing explanations and additional resources, induction programs, the establishment and maintenance of learning communities, group tutorials, and

individual feedback. (b) Managerial: keeping to the task, agenda, timetable, procedural rules, and decision-making norms and tracking student participation. (c) Social: creating a friendly social environment in which a climate of learning is promoted. (d) Technical: participants need to be comfortable with the system and the software in use. These competencies are not much different from the competencies of a classroom instructor. However, facilitators of online learning environments consistently report that greater cognitive effort, a wider range and depth of skills, and more time are required for effective facilitation. An elegantly designed learning environment can collapse and have less impact if the facilitator does not have the range of skills to engage earners and support them as they develop their own learning systems.

According to the ANTA study, there are several characteristics of the synchronous learning environment that challenge facilitators.

(1) The lack of non-verbal cues. Communication is more open to misinterpretation, and feedback requires more thought.
(2) Increased expectation from learners that instant technology means instant feedback. Learners are less tolerant of communication delays.
(3) An increase in one-to-one communication. Facilitators need to customize responses to individual inquiries. However, some facilitators establish a bank of Frequently Asked Questions (FAQs) to handle repetitive questions.
(4) More knowledge, thought, and effort are put into pacing, leading, questioning, and encouragement.

What strategies should online facilitators use? Here are some practical tips.

(1) Participate before you facilitate.
(2) Be an advocate for the virtual classroom within your organization.
(3) Practice, practice, and practice.
(4) Learn the technology well.
(5) Keep tuned in to participants.
(6) Record questions that are asked in the session's chat function.
(7) Use a teaching assistant.

Method 6: Other teaching means

Extension organizations are experimenting with other mass communications systems, many of them related to computers. Some examples of these are listed below.

(1) **Videotex:** A two-way interactive system that links computer databases to television sets, through telephone or cable television lines. Agricultural uses of Videotex are

being tested in many countries, including the UK, France, Germany, Denmark, the Netherlands, Canada, and the US.

(2) **Broadcast teletext:** A one-way, non-interactive system that transmits text and graphics through broadcast signals to television sets with special decoders. Teletext had been developed in more than 15 countries.

(3) **Slow-scan television:** This system makes picture communications possible through channels such as telephones, satellites, microwaves, and FM radio. Slow-scan television is being used in the South Pacific and other areas.

(4) **Communications satellites:** This system offers special potential for reaching remote areas. Agricultural uses of satellites are being tested in India, Peru, Indonesia, the Pacific nations, Canada, Alaska, Colombia, and the USSR, for example.

C. Projected visuals

Another group in the audio-visual category is projected visuals, such as motion pictures, slides, filmstrips, and overhead transparencies. They have much appeal, and are among the most effective of the visual leaching aids. It is as well to remember that they have important limitations as well as advantages. The main advantages of each type of projected visual are discussed in the sections that follow.

But, in general, the disadvantages or limitations are similar. Special equipment is required both to produce and show the visuals. This equipment tends to be relatively expensive, and some sort of electrical power is required to operate the projectors. Transportation, maintenance, and storage of equipment and materials require special consideration. If these limitations do not present a problem, projected visuals should be used as much as possible in your extension programs.

Method 1: Motion pictures

Motion pictures are really not "motion" pictures at all. They are a series of still pictures on a long strip of film. Each picture is flashed momentarily on the screen, and the rapid succession of still pictures, each showing the subject in a slightly different position, gives an illusion of movement.

Films have the potential to create powerful emotions and urges, and thus can be a tremendously effective tool in teaching. This means that selected and used properly, they can intensify the interest of an audience in the subject. Films are also excellent for showing the steps necessary in doing a task, or for showing a continuous action.

They can reproduce events long since past. They can record a demonstration that can be shown over and over again to many different people in many different places. They can

slow or accelerate motion for better analysis of action and growth. They can magnify on a screen action that normally would be too small to easily or clearly be seen by an individual or group. They can condense or stretch time. Many other strong points for using motion pictures could be mentioned, but the reasons already given are among the most important and help explain why films are a potent teaching tool.

For motivating an audience, for appealing to the emotions, for a clear and concise portrayal of action, few media approach the motion picture. It portrays reality.

The size of film most commonly used educational motion pictures is 16 mm or other sizes. Films, however, are not alike. Those made for silent viewing or with comments by a leader are made with sprocket holes on both sides of the film. Films made by professional laboratories to which sound is added have sprocket holes on only one side of the film. You should not attempt to project sound film on a silent projector because the teeth of the drive mechanism will punch holes in the sound track. Another difference is that silent films are made to operate at 16 frames per second or somewhat slower than sound film that runs at 24 frames per second. If a silent film is run at the speed for sound, the action will be speeded up.

In selecting a film to use in a given teaching situation, the same judgment must be exercised as in selecting other teaching aids and materials. In addition to the objectives, any previous experience of the audience must be considered, such as age, education, interests, and customs. A film should be used only as a teaching aid. Leaders frequently make the mistake of showing a film without preparing the audience or following up. Because movies sometimes cover too much ground or include too much detail (considering the experience of the audience), viewers often fail to fully understand the ideas presented.

To do the best job, leaders must first be thoroughly familiar with the subject to be taught. Leaders must know exactly how the film supports the ideas to be presented. Before showing the film, leaders should explain the lesson, tell why it is important, and stimulate viewers to look for certain things in the film. When this procedure is followed, the end of the film should be the signal for the beginning of a lively discussion and question period.

A successful film showing depends on looking after a number of details. An adequate power supply that matches the requirements of the projector is necessary. This means checking on details such as extension cords and electrical connections. Some means should be available to darken the room without cutting off ventilation. Spare projection lamps should be on hand. Before the audience arrives, the machine should be set up, threaded with film, focused on the screen, and tested.

The projector should be placed high enough to project over the heads of the audience and the screen high enough from the floor for everyone to see the bottom of the picture easily. A good rule is 1.2 m (4 ft) from the floor to the bottom of the screen.

Method 2: Slides and filmstrips

Slides are one of the most popular and versatile visuals that can be used in extension education. There are two types of slides. The first is referred to a "lantern slide." These were used in very early days and are almost never used today. The lantern slide measured 3 × 4.25" and is mounted in glass. The second, almost universal slide is the 35 mm or 2" (50 × 50 mm) slide. When 35 mm color film is used, a direct color positive transparency is the result. Some types of film can be home-processed, while others require commercial processing. When processed, the film is cut into individual pictures and mounted in cardboard or glass ready for projection.

Filmstrips are visuals that have been photographed on a continuous or strip of film and are projected in a special projector, one image at a time. Filmstrips require specialized production techniques that usually offset production economies for use by extension groups when small amounts of the material are needed. Filmstrips have the same advantages and disadvantages as slides with the exception that image sequences cannot be changed.

Slides and filmstrips have the following advantages.

(1) They can be made by the individual worker at low cost.
(2) They can be made either in natural color or in black and white.
(3) Both the slides and the projection equipment are relatively light and can be easily transported.
(4) Slide sequences can readily be changed to keep them timely and localized.
(5) The length of slide sequences can be changed to fit local needs.

Slides and filmstrips have these limitations.

(1) They do not show action.
(2) They normally require "live" narration, unless synchronized with a tape recorder.
(3) They require close cooperation with a projectionist throughout the presentation if the speaker desires to be in front of an audience, unless remote control equipment is available.
(4) Most importantly, they require a dependable source of main power or generating equipment, and maintenance. A supply of spare projection lamps is a must for the effective utilization of project visuals.

The same attention to meeting room preparation (screen placement, location and set-up of the projector, and room darkening) should be provided for showing slides and filmstrips, as discussed in the section on motion pictures.

Method 3: Overhead transparencies

The overhead projector is nowadays a common visual projection technique. It derives its name from the technique, whereby pictures or illustrations are projected over the head of the presenter.

This medium also has advantages and disadvantages. The most important advantage is that the projector may be used in normal daylight conditions, and presentation rooms do not require darkening. A second factor is that presentation transparencies are easy to prepare. The presenter or an artist/illustrator can draw or write directly on clear or colored acetate sheets using a variety of writing implements.

Wax marking pencils, various types of felt markers, and specially prepared pens with inks that project in color can be used to prepare the subject matter. An overhead projector cannot normally be used to project color transparencies, as 35 mm slides are too small for the projection optics. In addition, the optics are not designed for projection of continuous tones, and work best with lines and solid areas. Full-color transparencies similar to 35 mm slides also require darkened projection conditions. However, overhead projection transparencies can be produced from black and white copy transferred to special films for duplication in office copiers.

Overhead projection is a very versatile medium. Probably the most important factor is that the presenter maintains eye contact with the audience at all times. He or she can use techniques such as progressive disclosure to control the audience. The teacher can point to parts of the transparency for attention. Shapes, such as arrows, cut from cardstock can be used as add-on features to attract attention and emphasize. The presenter can also write directly on the film to add material or emphasize points.

The overhead projector uses electricity for the projection lamp. Its usage then is also linked to a dependable source of main power or a portable generator. Spare lamps are also vital for continued and efficient use.

D. Static media

There is also the static form of media for extension aids. This group of media derives its name from the fact that the material does not involve motion or sound. Examples are posters, flip charts, wall charts, maps, chalkboards (black or colored), magnetic boards, and flannel boards. All of these techniques require the use of some from of printed material. All can be effective when used properly. There are several drawbacks to their use, mainly due to the bulk of the materials which makes transport and storage difficult. Static media are often best used with small or intimate groups for maximum visibility.

Extension workers should keep the following in mind when designing any printed visual. Legibility of a letter is determined by letter height, line width, and letter style. Letter height is most important. A lower-case letter, such as an "e" that is 2.5 cm (1 in) in height is visible from a distance of 10 m (32 ft), a 5 cm (2 in) letter is visible at 20 m (64 ft), and a 1.8 cm (0.5 in) letter is visible at only a distance closer than 5 m (16 ft). Letters should be bold and simple; fancy type styles should be avoided.

When using static visuals, make sure they are displayed prominently and are well-lit, so that members of your audience can see them clearly. Make sure they are secure, so that you are not embarrassed by materials falling to the floor.

Method 1: Posters

A poster is a sheet of paper or cardboard with an illustration and, usually, a few simple words. It is designed to catch the attention of the passerby, emphasize a fact or an idea, and stimulate him or her either to support an idea, to obtain more information, or take some kind of action. People do not walk around studying posters. They look at posters in the same way as they look at trees, birds, houses, cows, or other people. A brief glance is usually as much as the average person gives an ordinary object, long enough only to identify it. If something about the object catches the attention or stimulates interest, the passerby will look at it longer. The design and use of posters as visuals in extension teaching are based on this principle.

Since a single glance may be all that any poster receives, the message must be simple and clear. Details and wordy sentences have no place here. A few suggestions for designing more attractive, effective posters are given below.

(1) Decide exactly who the audience is. Decide exactly what the poster must tell them. Decide what the audience should do.
(2) Put down on a sheet of paper words and rough pictures that express the message simply and clearly.
(3) Try to put the message into a few words, a concise, striking slogan. Visualize or picture the most important central idea in the message. Remember that words and pictures must be seen at a glance and must stimulate a response from the viewer.
(4) Rough out the poster in small scale, 1/3 or 1/4 actual size. If the services of an artist are available, he or she can produce an excellent finished poster from an original rough sketch.
(5) Use plain, bold lettering and lines. Use color to attract attention and for contrast (but remember that too many colors may cause confusion). Allow plenty of space, and do not crowd letters, words, or illustrations.

Posters should supplement, not replace, other communication methods. They are often used to "spearhead" or introduce a campaign, or they may be used to reinforce an

educational effort after it has been launched. In general, the greater the number of posters used in an area, the greater the impact, up to a certain point. Most people find it annoying to be bombarded at every turn by the same poster. Overuse of posters defeats their purpose and may actually turn people against the idea you are trying to get across. Discretion and good taste will suggest the number to use in a given situation.

Posters may be produced in quantity by letterpress, by offset printing, or by silk screening. Where only a small number is required, they may be produced by the individual, by an artist, or by other people such as schoolchildren. Posters are put up on walls of buildings, fences, trees, poles, bulletin boards, store windows, trucks, automobiles, and any other places where they are likely to be seen by people passing by.

Method 2: Exhibits and displays

Exhibits and displays have some of the same characteristics as posters, covered in the preceding section. The main differences are that exhibits and displays are usually larger and more detailed.

As with posters, the purpose of an exhibit or display is to catch the attention of passersby, impress on them a fact or an idea, stimulate interest in the subject matter presented, and possibly urge them to take some sort of action. Differing from a poster, however, the exhibit is larger, may have three dimensions and, most importantly, imparts more-detailed information than is possible with a poster.

Because of their larger size and because they are usually placed in a marketplace or other areas where people move slowly, exhibits and displays attract and hold attention for longer periods than posters. Even so, the periods are not long. The viewing time will depend on whether the exhibit is in an open area or in a separate enclosed room. Viewing time for an audience may be as short as 1 minute or as long as 10 minutes. On average, one should aim at telling the complete story in about 3 minutes. This means that whatever you can do to increase the attention-catching power of your exhibit increases its attractiveness and personal appeal, but keeps its content simple and clear. Doing these increases of the chances, the viewer will receive and understand your message. Again, as is true of all other visuals, planning is the first step in preparing exhibits and displays.

Decide who the audience is, what the message is, and what you want the audience to do. Answering these questions will help to plan the scope of the exhibit, the type of appeal to use, and the content. The most-effective exhibits are built around a single idea with a minimum of supporting information, in a few simple words and pictures, to tell farmers that a new seed variety is better and why, that is all.

Make a miniature of the exhibit from paper or cardboard. This will help visualize it at full scale. Experiment with colors and designs, and an artist's help in planning the arrangement would be helpful.

To attract attention and get people to stop and look at the exhibit, something that catches the eye should be included. This might be a live object, such as a sheep in an exhibit about sheep, or it might be color, movement, light, or any number of things suggested by a lively imagination.

One can try to define the "something" that causes people to stop and look for more detailed information. This "something" must produce a "mental shock". Once a person stops in front of an exhibit, he or she is susceptible to the rest of the message or messages in the exhibit. Incidentally, a walking person passes by an exhibit in about the same number of seconds as there are lineal feet in front of the booth. In other words if the booth is 10 ft (3 m) wide in front, a person has about 10 seconds to absorb enough of the intended message to be persuaded to stop and discover the rest. Thus it is obvious that the attention of passersby must be attracted in a very short time.

Make sure that the central idea of the exhibit stands out. The lesson taught must immediately be clear. A combination of real objects, models, or illustrative material plus a bold sign will usually get the point across.

Folk Media

Interest in the use of folk media is increasing in many less-industrialized countries. These media include theatre plays, songs, puppet shows, storytellers, and other traditional forms of entertainment.

It has been suggested that interest in folk media has increased because mass media have been less successful in promoting rural development than was expected. Alternative means of communication with rural people have therefore been sought. Another reason is that there has been a decreased emphasis on top-down communication with rural people in favor of participatory approaches. Folk media usually involve substantial participation.

These media often appeal to the emotions of members of the audience who identify themselves with the players. It is easier for them to identify with folk media because these fit closely with local cultural patterns, whereas the mass media bring information from urban centers and from foreign countries. Hence, folk media are often more effective at arousing motivation to change than in transferring knowledge to villagers about how to change. Furthermore, the audience tends to have confidence in the message because communication

Special Remarks

Dr. Thomas Lumpkin

Director General, AVRDC

Dear Participants,

I have a prepared seminar for presentation early this afternoon, and so I have not prepared and elaborated a welcoming speech for you. However, I would like to thank the organizers for putting together this meeting and especially those who provided plans for support for the meeting.

I would like to maybe spend a moment over-viewing my feelings about the world situation. I have seen for several decades now the declining support for agriculture research, declining support for development, for extension, for technology transfer. Like most organizations, most of you are probably in institutions that are struggling financially year after year, often having to make budget cuts year after year. In today's world there is general complacency about the food security situation. Leaders are not worried about food. They only worry about conditions until the next election, until the next change of government they just want to survive until that time. They are not worried that ten years from now, if we will have the food, we will have the agriculture economy that a nation deserves. Unfortunately at this time we have some world leaders who feel that force is the answer to the many problems of the world. We are seeing more wars and more chaos in the world, this situation has made it very difficult to have the kind of meeting we are having today. The world situation is making it more and more difficult for North-South, for South-South meetings to occur.

At present, IFPRI (International Food Policy Research Institute) has said that the world generally has enough food, if distribution is not considered. There are places in the world that are lacking in food, especially now in Southern Africa, in places where social chaos has occurred. But we do not know what the future is going to bring, particularly in ten or twenty years. What is going to happen with global warming, what is going to happen with the availability of fuel for fertilizers? So there are many questions about inputs, there are also questions about biotechnology. Many of you are interested in biotechnology but you are also very concerned about some unintended consequences, some unintended impacts that it may have, some dangers that it might bring. These are questions that need to be addressed, need to be looked at, but very little has been invested by developed country governments to

takes place in a form they are accustomed to, in their dialect, and often from people they know. It might be acceptable for players to ridicule people who prefer to stick to the old ways, whereas it would be unacceptable for a government extension agent to do so.

Extension organizations can stimulate participation by arranging competitions for the best plays.

This appears to be a relatively inexpensive extension method. Folk and modern media do not have to compete, but can complement each other. Thus, folk media can be shown on television, and folksongs with a development theme can be broadcast on radio. This is often done in some Asian countries, partly because governments see it as a way of promoting national unity. A Brazilian agricultural extension service commissioned a popular folk singer to write and perform folksongs that incorporate technical messages about fertilizer use.

Conclusions

Rural people obtain information from many sources. Research has shown that sources most used by farmers vary with the stages described in the introduction chapter on the adoption or diffusion process. These studies indicate that mass media are most important in attracting awareness and interest. Friends and neighbors are first in importance in the evaluation, trial, and adoption stages. The second rank of important sources is friends and neighbors for awareness and interest, while it is government agencies (including extension workers) for the other three stages.

Government agencies come in third place in securing awareness and interest. In addition to extension workers, sources include vocational teachers of agricultural and home economics, soil conservation service, and other agencies of the agricultural ministry and local governments. Dealers and salesmen are acknowledged, but they take [fourth?] place in importance. A very significant finding in this research is the extent to which farmers say they rely on friends and neighbors at all stages in the diffusion of knowledge.

Many factors enter into the selection of suitable extension methods. Strictly speaking, what we call methods are often tools that we may apply in different ways. Basically, individual contact methods furnish the most-direct opportunities for influencing people. All other tools of group and mass procedures are dilutions or compromises created by the pressure of necessity. Extension workers must reach more people, reach them more often, and keep down the cost per contact. As more contacts are better than any single method, our concerns should be directed to the following points: (1) what all the tools are, (2) what each has to contribute, and (3) what the best combination of personal, group, and mass media is for a

specific plan of work or educational campaign.

Other considerations related to the selection of suitable technology transfer methods are:

(1) The length of time the program has been under way in an area;
(2) The character and stage of development of the program, for example results demonstrations may no longer need to provide the proof of recommended practices;
(3) The personality and skills of available workers both paid and volunteer;
(4) The gender, age, education, motives, and other complex human characteristics and customs of the people to be reached;
(5) General local conditions, such as seasonal work, weather conditions, available meeting places, organization, and leadership; and
(6) Financial and other resources, such as equipment, including returns per unit of time spent on the method.

This list is incomplete. It is only suggestive of the many items which may be considered in choosing the "kit of tools" to be used. These tools should be flexible and capable of easy adaptation to changing conditions. It is important to use the right methods and tools in the right proportions at the right time.

Modern information technology can give farmers rapid access to a large amount of information, help them select exactly what information from this they need for their decision-making, and with the assistance of decision-making models, guide their decision-making processes. Modern computers have become much more user-friendly. Previously, the mass media gave generalized advice to farmers, but with modern information technology, extension services can provide advice custom-tailored to each farm and farmer without visiting the farm personally. This makes it possible to combine some of the advantages of mass media with those of farm visits. The methodology for technology transfer in the 21st century will undergo many changes, but the deliverer of technology and/or relevant information that embraces the challenges with an innovative and imaginative eye will profit from pioneering efforts in the use of new global or local delivery systems. In the Information Age, the saying, "survival of the smartest" will undoubtedly take precedent over "survival of the fittest".

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Technology Transfer through Information Dissemination: FFTC in the Sustainable Agriculture Partnership[1]

Te-Yeh Ku[2]

ABSTRACT

The Food and Fertilizer Technology Center (FFTC) for the Asian and Pacific Region was established in response to severe periodic shortages of both food and fertilizer in the 1970s. It was apparent at that time that a lack of technical information among farmers was the basis of the problem, compounded by an inadequate fertilizer supply and a shortage of improved seeds. To alleviate these problems, the FFTC has been steadfastly fulfilling its mission of providing farmers with practical information about new technologies. It has not usually contacted farmers directly, but has supplied technical information to teachers, extension staff, and others who act as disseminators of information. The Center is the only organization of its type operating within the Asian-Pacific region. For the past few years, all those working for and with the Center have tried to collect and disseminate useful information on agricultural technology and policy, for the benefit of farmers of the region. The impressive body of work of this small organization provides testament to the widespread support and cooperation it has received over the years. With 33 years of service in this age of information, the Center carries on its mandate. There is an abundance of scientific information available in publications and on websites. However, its value still lies in meeting the information needs of the user. By promoting exchanges of information, the FFTC helps ensure that extension specialists and scientists in the region are aware of useful technology being developed in neighboring countries. Discussions at the Center's international meetings and through international networks set up by the Center maintain an on-going dialogue between those who provide technical information and those who make use of it. The Center will continue to provide information that will help farmers increase their incomes. In its future programs, the Center will continue to focus its efforts toward sustainable productivity and the sustainable management of resources. This report describes some of the Center's major activities,

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achievements, future aspects and the role it has played in the dissemination of information for the development of sustainable agriculture in the region.

Introduction to the Mission of the FFTC

An important source of technical information

The Food and Fertilizer Technology Center (FFTC) for the Asian and Pacific Region has an unusual role among the world's international agricultural centers. It collects and disseminates research results generated mainly by agricultural centers in the Asian-Pacific Region. The aim is to provide farmers with improved information about new technology, so that they can achieve higher yields and incomes.

The world has evolved a highly effective research system for developing new agricultural technology. It has been less successful in making use of this research. Large amounts of research data are being generated every year. However, a great deal of it is not being put to any practical use. The success of practical agricultural research should be seen, not in the prizes or promotions it brings to scientists, but in the benefits it brings to farmers and consumers.

The Center was established in 1970 to act as a clearinghouse for research carried out in the region, and to help bring the results to farmers. It is always difficult to quantify the impact of information on farm production. However, it is certain that the Center's work over the years has provided a great many scientists and extension specialists in the region with important technical information to meet farmers' needs. Moreover, it was an important source – sometimes the only source – of technical information from other countries in the region.

A clearinghouse for regional research

The Center also acts as an intermediary between international and national agricultural institutes in the Asian-Pacific region. In this way, the Center makes research from each country available to its neighbors. This provides a greater scope for collaborative work, and helps avoid duplication of effort. The Center's information services have always had a regional focus, and all its programs involve groups of Asian-Pacific countries.

As it developed its information programs, the Center has been concerned with technology suited to the small-scale farms of the Asian-Pacific region. Technology of this kind requires a rather small capital investment, compared to the capital-intensive farming of Western countries. It makes intensive use of small land holdings, and it has a relatively low risk.

The technology disseminated by the FFTC covers a wide range, from the protected cultivation of high-value crops to low-cost and practical technology which uses on-farm resources, such as crop by-products for livestock feed. It also covers post-harvest handling and marketing, and other aspects of agricultural economics.

Background of the FFTC

Programs on food production

The period when the Center was established in 1970 was at a time of food scarcity. There was a regional shortage of both rice and fertilizers, and many people feared that there were worse shortages to come. The Center was established to help raise farm incomes and agricultural yields of the Asian-Pacific region by improved technology, especially fertilizers and improved varieties. Hence the Center's name: The Food and Fertilizer Technology Center for the Asian and Pacific Region.

Information for small-scale farmers

Some problems in the region are common to farmers all over the world. Others are specific to the region. Asia must feed 60% of the world's population from less than one-third of its land. The average size of land holdings is small, often less than one hectare (2.6 acres). During the past 40 years, the technology of the Green Revolution has transformed Asia's agriculture. Country after country has moved from a shortage of staple foods into a surplus. Average crop yields have risen to levels never seen before. In recent years, the focus has been on sustainable agriculture, and on helping Asian farmers survive in an era of trade liberalization.

Over the years, the programs held by the Center have adapted to meet the changing needs of the region's farmers. However, the focus of all its work has remained the same: small-scale farms of the Asian-Pacific region.

Organization and Funding

The Center's professional staff is composed of specialists from various agricultural disciplines. They are recruited internationally from countries in the Asian-Pacific region. The administrative staff is employed locally. Both are under the supervision of the Director, who is appointed by the Executive Board.

The Center is advised about its policies and programs by the Technical Advisory Committee (TAC), made up of distinguished agricultural scientists in the region. Most of them have worked with farmers and have been involved in agricultural development programs.

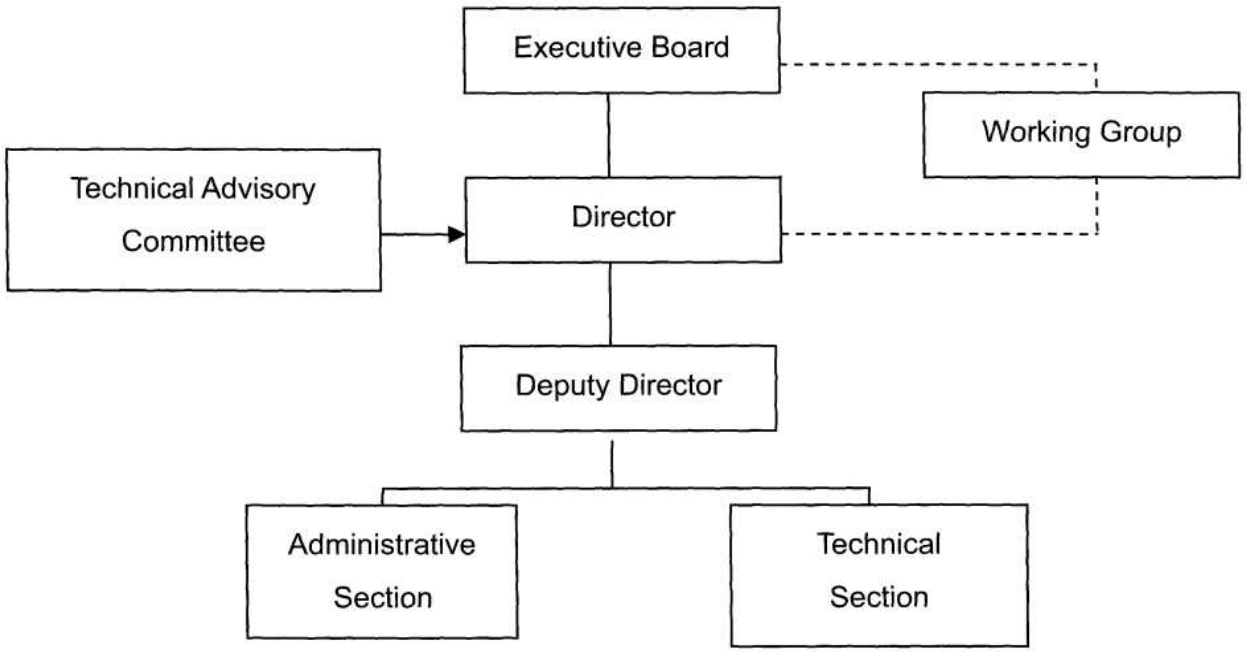
The TAC meets once every 2 years in a member country in turn, to identify information needs, evaluate the effectiveness of the Center's work, and make recommendations on how the Center might improve its future work programs.

The Center works in close cooperation with national and international agricultural centers in the region. All its programs for collecting and disseminating information are carried out with the help of co-sponsors, who support these programs with funding, personnel, or both. The Center also consults other agricultural centers in developing all its annual work programs. The Center makes every effort to ensure that its information programs address major regional problems and meet actual regional needs. The operation and management activities of the Center are voluntarily funded by five member countries which are represented on the Center's Executive Board and Working Group.

Other countries, including Malaysia, Thailand, and Indonesia, provide funds and other support on a project-by-project basis. All the Center's programs are international, and are carried out in countries of the Asian-Pacific region in cooperation with other agricultural centers and institutes.

The Center is based in Taipei, Taiwan, ROC. The policies of the Center are decided by the Executive Board, made up of senior officials from the member countries. The Board also establishes operational procedures and approves the Center's annual work programs and budget.

The Executive Board is assisted by the Working Group, also made up of representatives from the member countries who help Board members with technical advice and support. Both the Executive Board and the Working Group meet twice a year in Taipei. The organization structure of the Center is illustrated as follows:



FFTC Information Programs

The Center's information work is broad-based, reflecting the information needs of small-scale farmers in the region. Asian farmers generally grow a mixture of several crops, and many of them keep livestock as well. Their income is determined by total farm production, not by the performance of any single crop. To make it useful, the Center's information work covers the full range of farm activities such as crop and livestock production, plant protection, soil and fertilizer management, and post-harvest activities, etc. In collecting and disseminating information, the Center is concerned with practical technology which can be applied on farms.

The Center does not disseminate information directly to farmers. There are too many of them, and many different languages are used in the region. Instead, the Center disseminates technical information to people working for national extension systems, and other people who work with farmers and act as "multipliers of information". Information collected by the Center can also be transferred to farmers by means of "training the trainers" so that those trainers can then channel information into the hands of needy farmers.

The Center makes every effort to maintain high standards of relevance in its information programs. It repeatedly reviews the information it disseminates, evaluates its program activities, and consolidates its work by conducting follow-up projects.

The first decade: Increased food production

The early programs of the Center focused on increasing food production to meet a regional shortage of staple foods. At that time, the technology of chemical fertilizers and high-yield varieties was just coming into use in most countries in the region. Fertilizer management was an important topic of the Center's early programs, especially for rice. Information was also collected and disseminated on improved crop varieties and chemical pest control.

Agricultural cooperatives were important in helping Asian farmers make the change from subsistence to commercial farming. Early programs of the Center included the management of cooperatives as a source of farm inputs and farm credit. Other programs were concerned with the economics of fertilizer use, and post-harvest handling and marketing.

In tropical and subtropical Asia, farmers can often grow three or more crops each year in the same field. Multiple cropping programs were important during the Center's early years. Livestock was also emphasized, both for draft use and for sale. Early programs emphasized integrated crop/livestock/fish farming.

Use of on-farm resources

The earnings of small-scale farmers are limited by the size of their farms, and so is the scale of their investment. Many useful technologies may be too expensive for such farmers. Labor-saving methods using inputs produced on the farm itself are often those which are most suitable for small farms.

The information collected and disseminated by the FFTC has always included low-cost, low-risk technology. This includes using crop by-products as raw materials for composting or for livestock feed.

An important topic has been the biological control of pests and diseases. Sometimes this involves the mass release of natural enemies. Other approaches include new cropping systems which create a habitat which is unfavorable to pests and diseases.

For livestock, the emphasis has been on hardy local breeds, rather than imported high-performance animals which need good management if they are to survive. The Center has also collected and disseminated technology developed by farmers themselves, using local resources.

The second decade: Diversification for higher incomes

By the beginning of the 1980s, costs of farm inputs were rising rapidly. The Center began a new series of programs on improved uses of alternative resources. These included nutrient recycling, the use of green manures, and biological nitrogen fixation.

At that time, many countries in the region were rapidly developing. Economic success produced higher incomes. There was a growing interest in diversification as a way of improving farm incomes and meeting the needs of urban consumers. The Center's programs focused on the production of a greater range of crops, especially high-value crops such as fruits and vegetables. There were also many programs on livestock production and management.

Fruit and vegetable crops have special marketing problems compared to field crops. They are bulky to transport, and highly perishable. Seasonal gluts and shortages lead to wide price fluctuations.

Some of the Center's programs at that time focused on post-harvest handling and marketing of horticultural crops. Others were concerned with the use of low-cost plastic structures. These allow farmers to harvest crops out of season, when prices are higher.

Sloping agricultural land technology (SALT)

SALT technology is a simple and low-cost method of farming in slopeland areas without loss of topsoil. Hedgerows of leguminous trees and grasses are planted along the contour

lines. Crops are grown in the spaces between the hedgerows. Sometimes goats or other small livestock are kept, and are fed on crop residues and fodder cut from the hedgerows. Since the animals are penned, their manure can be collected and used as fertilizer. Livestock offers a high profit per unit of labor invested. They are easier to market than most crops.

The third decade: Sustainable agriculture

In the 1990s, we all began to be aware of the environmental aspects of agriculture and to take into account the long-term costs of intensive agriculture based on short-term returns. Every country in the region was experiencing a decline in the quality of many agricultural soils, waterways, and forests. Accordingly, the information programs of the Center began focusing on sustainable agriculture, which maintains soil fertility and conserves the resource base for future generations.

Efficient fertilizer use is a vital part of sustainable agriculture. Many programs were held on soil testing, plant analysis, and crop nutrient management. Slopelands all over the region are deteriorating under intensive agriculture. Sustainable cropping systems for slopelands often combine food crops with agro-forestry or livestock. Production technology includes low-cost conservation methods such as contour planting.

Sustainable agriculture does not necessarily mean organic agriculture. The Center's programs for Asia emphasize combined use of organic and chemical inputs. Organic cropping is difficult in the tropics. Nutrients are quickly leached from tropical soils, and pests are numerous.

Programs for the new millennium

The overall policy of the new millennium is to promote sustainable development. The Center's programs aim to improve productivity, foster the sustainable use of soil and water resources, enhance the rational use of fertilizers, and promote systems of integrated pest management which make minimal use of chemicals.

Sustainable management of soil and water resources will be a central theme. This must be a basic part of Asia's future agriculture. Where current agricultural methods lead to soil loss and reduced fertility, new technologies need to be extended. Monitoring is important, so that each country can detect environmental problems at an early stage, when they can more easily be remedied.

address these valid concerns. Most investment has been through private companies that are not interested in seeing governmental regulation. They don't want the governments to get involved in safety. So this is a world situation that is not very bright for agriculture research and development, and especially in technology transfer. All of us who are involved in this area must get involved with our governments and encourage our politicians to take a more keen interest in technology transfer, in technological development in agriculture. At AVRDC – the World Vegetable Center we are pushing hard to play a role in this and I would like to elaborate on that topic more in my presentation. Again, I wish to thank the organizers of this meeting.

Agriculture is not sustainable unless it is profitable. The Center's programs will focus on improving farm incomes, including new sources such as agricultural tourism. Increases in income, rather than increases in yield, are the ultimate goal. FFTC programs will also collect and disseminate information on how to reduce production and marketing costs, in order to make Asian farmers more competitive.

FFTC Activities Regarding Information Collection and Dissemination

A. Collection of Information

The Center collects technical information from research institutes and extension centers throughout the Asian-Pacific region. One important source of information is a regional network of national extension systems. Cooperating organizations in the network send in information, and evaluate the information collected by the FFTC. The Center also holds seminars and workshops to discuss urgent regional problems, and publishes the information from these. The scientific staff also carries out surveys to collect information with the help of local cooperating organizations.

Information is disseminated in several ways. The Center disseminates information in its publications, which are sent free of charge to selected agricultural libraries in the region. They are also made available on its website and database.

The Center also holds follow-up projects such as training courses to disseminate useful new technology. It has organized a number of long-term demonstration projects in member countries, some of which have gone on to become national programs.

The FFTC develops its work programs in close consultation with other agricultural centers in the region. At least one of these, and usually several of them, act as co-sponsors of each program. The co-sponsors help with the organizing work, and provide staff, funding, and various facilities. Most importantly, they provide ideas, and help the FFTC to identify the important problems of the region's farmers.

From 1970 to December of 2002, the Center carried out various forms of international cooperative ventures such as sponsoring 38 training courses and 162 international workshops and seminars. More than 12,000 people working in agriculture have attended these meetings, not counting many thousands of observers. The participants included government officials, research scientists, and extension staff. They came from 37 countries, most of them in the Asian-Pacific region.

Activity flow

In identifying problem areas and defining the most feasible way to tackle a specific problem, the Center regularly adopts the following sequence of activities:

*Surveys to obtain benchmark information;

*Seminars and workshops to develop feasible solutions; and

*Publications and training courses to disseminate the technical know-how or management skills to those who will use them to benefit farmers.

1. Surveys

The staff of the Center carries out various types of surveys so that they can make an in-depth assessment of a particular problem. Surveys are often concurrently carried out in several countries of the region. This gives the survey team a comparative idea of how serious a problem is, and ways in which it affects different countries in the region.

1) Survey of fertilizer

In keeping with the Center's focus on fertilizer, the first survey carried out by the FFTC, in 1973, was of the regional fertilizer situation. This was repeated 10 years later to monitor changes. A more-recent survey looked at chemical pesticides and herbicides in the region, including distribution channels, patterns of usage, and health and environmental issues.

2) Survey of applied biotechnology

Biotechnology is sometimes seen as high-level technology for industrialized countries. However, it can make great contributions to Asian smallholders if scientists and research institutes in Asia were to focus on farmers' needs. The FFTC has carried out a survey on applied biotechnology in livestock production for which we collected information on the use of biotechnology in making cheap, effective vaccines for livestock, improving the nutritional value of various feedstuffs, and increasing the reproductive rate.

3) Survey of post-harvest and extension systems

FFTC surveys have collected information on many other topics, including post-harvest losses of fruit and vegetables, and their causes. The results have served as a basis for workshops and training courses concerned with marketing and post-harvest handling. An important topic of surveys has been the region's national extension systems, in order to define information flows and determine more about the information needs of farmers.

4) Survey of plant virus diseases

A major survey project spanning more than 12 years has been concerned with virus diseases of crops. This work has been supported by a special grant from one of the member countries.

The survey was carried out in 12 Asian-Pacific countries by interdisciplinary teams. They previously believed that virus diseases were particularly destructive to perennial crops which are propagated vegetatively (Seeds generally break the cycle of virus transmission).

Virus diseases of crops are difficult to diagnose on the basis of visible symptoms, as these vary from one plant to another, and sometimes resemble the symptoms of nutrient disorders. Once a plant is infected, it cannot be cured. Infected plants must be destroyed, and replaced with disease-free seedlings.

Even replanting may not solve the virus problem. The FFTC found that many young seedlings in plant nurseries were already infected. They had been grown from cuttings taken from parent stock which was infected with the virus but did not yet show symptoms. The information from such long-term survey projects was the basis of a series of FFTC programs which disseminated new methods of diagnosing plant viruses, and which helped establish disease-free nursery systems for seedlings.

2. Seminars and workshops

Seminars and workshops are a major source of technical information. Each year, the Center holds three to five seminars and workshops in different Asian countries. At these international meetings, experts discuss problems identified by the surveys and try to find solutions. Seminars focus on research results and policy issues. Workshops are more concerned with the practical extension and application of new technology.

National and international agencies based in the country where the meetings are held act as co-sponsors, and provide the venue and other support services. Over the years, the Center has built up strong links with other agricultural centers in the region.

It consults with these other centers regularly to ensure that the topics of the Center's seminars and workshops do not overlap with those of other centers, and that they fill important information gaps.

3. Regional network

In the year of 2000, the Center carried out a survey to clarify information flows in national extension systems in the region. The FFTC survey team visited eight countries to discuss with extension staff how and from where to collect information on new technologies in each country, and how and where to disseminate them to other countries.

As a result of the survey, FFTC was able to establish a network for the collection and dissemination of technical information. Initially, it covered eight countries: Indonesia, Japan, Korea, Malaysia, Philippines, Taiwan, Thailand, and Vietnam.

Cooperating agencies in each country in the network contribute information which is published by the FFTC in leaflet form. The network of coordinators also selects and translates

suitable technologies from the leaflets for extension use in their own countries.

Another important function of the network is assessment. The coordinators review leaflets during and after preparation. The FFTC follows their recommendations to ensure that the leaflets are topical and useful.

The FFTC hopes to extend the network in the future to cover more Asian-Pacific countries, and to monitor the information needs of the region's small-scale farmers.

B. Dissemination of information

1. Training courses

The Center holds training courses to show participants some useful new techniques or management skills. Some training courses are for scientists, such as courses on new methods of indexing plant viruses, or testing fruit and vegetables for pesticide residues.

Other training courses are for farming leaders and extension workers. Several of these have been concerned with livestock. One popular training course was on the production of mule ducks (a sterile interspecific hybrid which is an excellent meat duck). Another was on the use of biotechnology for breeding cattle and water buffalo. Other courses have been concerned with crop production, particularly multiple cropping, crop-livestock integration, and sustainable farming systems for slopelands.

Training courses are always international in terms of both the tutors and trainees. Often the same training course is held in different countries in turn, so that the maximum number of people can attend. Training courses always cover practical techniques, and include hands-on training as well as lectures. Trainees are from Asian-Pacific countries. The techniques they are taught are intended to bring immediate benefit to the farmers they work with.

The FFTC has held a number of training courses on the diagnosis and indexing of plant virus diseases. After conducting the training, it provided the molecular diagnostic probes to national laboratories in Indonesia, Japan, Korea, Malaysia, Philippines, and Thailand. It has also held training courses on the propagation of disease-free planting materials. The aim is to help countries in the region develop national systems to provide small-scale farmers with disease-free planting materials.

2. Distribution of publications

In spite of new information technology, the printed page is still the most important way of communicating technical information between countries. Publication is a major work program of the Center. It includes technical and extension bulletins, a book series, newsletters, and a regular publication which gives statistical information about important agricultural indices in the region.

In 2001, the FFTC began publishing two new types of leaflets. The "Practical Technology" series consists of extension leaflets for small-scale farmers in the Asian-Pacific region. Most of the leaflets are based on technology provided by an international network of cooperating agencies. The same network helps to translate the leaflets and disseminate the information to farmers.

The series "Research Highlights" summarizes important agricultural research which has recently taken place in the Asian-Pacific region. This series is intended for scientists in the region, to help them keep up with new developments in neighboring countries.

Since its inception, the Center has distributed more than two million publications free of charge to libraries and agricultural workers in 80 countries. Most of the publications are sent to countries in the Asian-Pacific region. They are also made available free of charge on the Center's website and database.

The Center's publications disseminate applied agricultural research, rather than basic research. There is an emphasis on practical technology for small farms in Asia, rather than basic research.

The Center's publications over the past three decades constitute a huge database of practical technology for small farms in the region. This technology covers the full range of on-farm activities in both tropical and temperate Asian countries. By May 2002, the Center had distributed:

* 664 free agricultural Bulletins (509 Extension Bulletins and 155 Technical Bulletins, a total of more than two million copies); and
* 59 books, all distributed free of charge to more than 1000 libraries in the region.

3. Access to our website and database

Access to computers and the Internet is growing rapidly in the region. Most universities, research institutes, and national extension headquarters are now using information technology.

The FFTC is making increasing use of the Internet as a cost-effective way of disseminating information. The Center has established an on-line database. It has a search function, so that users can quickly find the specific information they need. It can be accessed via the Center's website at http://www.fftc.agnet.org

The website also has details of FFTC activities and programs.

The database gives all users free access to the full text of its books, bulletins, and leaflets published since 1990. The publications are available as text-only HTML files with linked images, or as PDF files.

The database is being continually expanded and updated, and is now available on CD-ROMs. Materials in the database include the extension leaflets and manuals published by the FFTC.

The database is intended primarily as an information resource for national extension systems of the Asian-Pacific region. The information it contains, including the extension leaflets, can be downloaded, translated, or adapted in other ways to meet the information needs of local farmers.

4. Field demonstrations

A practical field demonstration of a new technology can sometimes give more information to farmers than any number of written words. The Center has carried out a series of field demonstration projects, in cooperation with national agricultural centers in the country concerned. For example, the first demonstration, in 1971, was held in the Philippines and was concerned with multiple cropping. Over the next 5 years this program was expanded to ten sites, and went on to become a national program. Later, two long-term field demonstrations were organized in Thailand. One was on pasture production under coconut palms, to give farmers extra income from raising livestock on fodder from coconut plantations. The other was located near the northern city of Chiang Mai, a major vegetable production area. It showed farmers low-cost improved methods of vegetable production, using mulches and drip irrigation. These were followed by a field demonstration program carried out in several sites in the Philippines. It demonstrated the production of corn and other crops in lowland paddy fields during the off-season.

A recent field demonstration project is a citrus orchard in Vietnam, which shows how to manage a disease-free orchard. The first step is disease-free seedlings, using the technology disseminated by the FFTC. The problem then is how to keep the trees free of viruses.

The demonstration orchard uses a range of modern techniques. They are proving very effective. They include monitoring the population dynamics of the vectors and aphids which spread the diseases. Pesticide sprays are properly applied when numbers of the vectors increase. The young trees are regularly tested for viruses and greening. There are also periodic inspections of inoculum sources of the greening pathogen, citrus viruses, citrus canker, etc.

Although these methods may seem rather complex, they are successfully followed by farmers in Taiwan. They seem to be the only way to keep orchards healthy in tropical Asia. Each tree receives standard treatment in terms of fertilizer, watering, drainage, pruning, and harvest.

The Future Outlook: Information Needs of Asian Farmers

Sustainable agriculture for small farms

Since the Center was established in 1970, the technology of improved varieties and chemical fertilizers, which the Center has helped promote throughout the region, has proven very successful. By the end of the 1980s, one Asian country after another had become self-sufficient in rice. For a while, it seemed as if food shortages would soon be a thing of the past. Nowadays, the outlook is bleaker. Yield increases may be reaching an upper limit. Since the mid-1980s, food production per capita has been declining.

The ratio between population and food in the region seems to be getting worse rather than better. In low-income countries, the production of staple foods and the funds available to pay for imports are no longer keeping up with population growth. The area of arable land is shrinking, as urban and industrial zones continue to expand.

The Center's future programs will collect and disseminate information that will help farmers in the region maintain and expand their gains of the past. Asian farmers will need information on cropping patterns and agricultural practices which provide resilience in the face of unpredictable weather changes.

Another important topic will be the multifunctionality of agriculture. We are becoming aware that as well as food and other commodities, agriculture provides many additional benefits.

For example, the benefits of irrigated rice farming are particularly high. They include flood prevention and conservation of groundwater. Some studies have found that the value of such benefits is even greater than that of the harvested rice. If agriculture is providing these benefits to society, perhaps we should find ways for society to reward farmers for providing them.

Sustainable uses of agricultural resources

All over the world, agricultural productivity is under threat or in decline, especially in the tropics. If Asian agriculture is to continue to feed Asia's huge populations, the agricultural resource base must be conserved. The most important components are the soil, water, and genetic resources of both plants and animals.

Sustainable agriculture is based on the efficient management of agricultural resources. This will allow the resource base to remain productive indefinitely, so that it can support Asia's future generations.

The Center will continue to collect and disseminate information on sustainable agriculture. By this, we mean agriculture which not only protects the environment, but is profitable and acceptable to farmers.

1. Soils

Soils are the basic resource of agricultural systems. Regardless of the crop, production systems must protect the soil from erosion and contamination, and maintain its fertility. The Center's programs will promote sustainable soil management for both lowland and slopeland areas, to maintain and improve soil fertility.

2. Fertilizers

Fertilizer programs will emphasize the efficient use of fertilizers, both organic and inorganic. Efficient fertilizer use means a good match between fertilizer applications and the nutrient needs of the crop. Plants do not suffer from a deficiency of any nutrient, but no excess nutrients are applied. To achieve this, farmers need to know the nutrient status of both the soil and crop. Soil testing and plant analysis will be emphasized, including testing systems suitable for small-scale farms. Other important topics will be recycling of plant nutrients and composting.

3. Water

Water resources are already a limiting factor for the region's agriculture. The situation is likely to become worse. In every Asian nation, industrialization and cities are taking more and more of the available water supply. Global warming and climatic change may make rainfall less predictable, which will render it difficult for farmers to plan their crops. FFTC information programs will include water-saving strategies for both irrigated and rain-fed cropping systems.

Overall, the Center will continue to promote the production and improvement of food crops and livestock by small-scale farmers, in a way which addresses the totality of production, post-production, and marketing systems.

Sustainability in agricultural development is not an alternative, but a necessity. If sustainable land use is not achieved, long-term trends will still continue and major changes will occur, but they will be negative and destructive ones.

4. Livestock resources

Livestock will continue to be an important topic in the Center's information programs. The Center's programs will collect and disseminate information on feeding and management practices which are suited to small farm production. They will cover improved feeds and nutrition, breeding, and animal health.

Livestock health problems will be a major concern, including emerging infectious diseases. Other programs will be concerned with technology to improve reproductive performance, and to increase the value of livestock products.

Asian farmers in an era of free trade

1. No alternative to agriculture

The Uruguay round of GATT ushered in a new era of global free trade, under the WTO. For many years, most Asian countries have been protecting their farmers with production subsidies, import tariffs, and price supports. Some, such as Thailand and Malaysia, are major world exporters of agricultural products, but most Asian countries have large numbers of farmers on small farms. Even before the WTO, farmers had marketing problems. Now, their problems have become critical.

Under the WTO, production subsidies and price supports will have to be reduced or removed altogether. Just as they have lost these supports, Asian farmers are having to compete with cheap imported produce in their own domestic markets. At the same time, farmers are under pressure to consider the long-term impacts of their farm practices and to protect the environment.

The region's farmers will need to be well informed if they are to prosper under a free-trade system, while conserving natural resources. Traditionally, Asian agriculture has been based on small farms run mainly by family labor. In the production of staple crops, such farms are at a disadvantage when competing with large, well-capitalized land holdings in countries overseas.

2. Improved management and new sources of income

Unless small-scale farms in the region develop new forms of production or find new sources of income, they may not survive. Widespread failure of farms in the countryside will add enormously to the problems of Asia's crowded cities, and add huge numbers of people to what are already overcrowded labor markets.

The Center's information work will aim at increasing the sustainability of small farms in the region. The two keys to future viability are improved management (including an increase in the scale of farm operations) and new sources of farm income. The Center will collect and disseminate information on new and promising ways in which farmers can earn extra income.

These will include agricultural tourism in generating farm income from home-stays, food processing, and other rural industries, new specialty crops, and organically grown foods. There will be an emphasis on production for niche markets, and on quality rather than quantity in agricultural production.

3. Agricultural cooperatives

Agricultural cooperatives have been very helpful in helping small-scale farmers achieve economies of scale in both production and marketing. In many countries, they have also eased the transition into modern commercial agriculture by providing farmers with farm inputs and credit.

4. Other forms of organization

Asian agriculture of the future is likely to see the development of other forms of organization which link industry and agriculture, and crop and livestock production. Wherever these benefit small-scale farmers, the Center will collect and disseminate information about them.

Global free trade will tend to primarily benefit farmers with good access to information and low production costs. There is not much that small-scale Asian farmers can do to increase the size of their land holdings – the dense populations of Asia and the high price of land will always be a limitation. However, there is a great deal they can do to reduce their production costs and increase the value of their produce. Relevant and timely technical information may make all the difference in whether the region's farmers are able to use their land effectively and productively, growing high-quality crops for which there is good market demand.

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Special Address

Dr. Torng-Chuang Wu

Director General, FFTC

Dr. Ming-lai Wang, Director General of the International Cooperation Department of COA, Dr. Munip, Secretary General of AARDO, Dr. Chien-yih Lin, Director General of TARI, distinguished guests, ladies and gentlemen:

It is a great honor to be invited to attend this International Workshop on Agricultural Technology Transfer and Its Consequences. First of all, on behalf of the Food and Fertilizer Technology Center for the Asian and Pacific Region, I should like to congratulate AARDO and COA for holding this timely and important workshop. The topics we shall be discussing are of central importance in combating world hunger and poverty. The future of the rural people in Africa and Asia, as well as in other parts of the world, will depend largely on how well we understand and solve the problems of technology development, technology adoption, technology transfer, and the impact of new technology on agricultural and socio-economic development. This meeting, with so many participants with experience of technical development, is a valuable opportunity for us to enlarge both our knowledge and our understanding.

Nowadays, how to achieve the sustainable development of agriculture under the impact of global free trade is a major challenge to most countries in Africa and Asia. In both regions, agricultural productivity is under threat or in decline, especially in the tropics. If agriculture is to continue to feed our huge populations, the agricultural resource base must be conserved. The most important resources to be protected and maintained are soil, water, and the genetic resources of both plants and animals. Unless we can maintain these resources in good condition for the generations to come, we face a terrible future of widespread food shortages and social breakdown. Sustainability in agricultural development is not an alternative, but a necessity.

As we face the new era of global free trade, those of us working to develop agriculture in African and Asian countries need to adapt our concepts of both agriculture and rural development, in order to make our farmers more competitive. Global free trade in agricultural products tends to benefit primarily farmers with good access to new technology and low production costs. Relevant and timely technical information may make all the difference as to whether our farmers are able to use their agricultural resources effectively and productively. Our farmers in both Asia and Africa need to be well informed, if they are to prosper under a

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Agricultural Extension Services and Innovation Adoptions in Taiwan[1]

Yung-Chung Chiu[2]

Introduction

Agricultural extension is actually a type of industry that manages changes. Agricultural producers, agri-business enterprises, farmers' groups, and consumers are the clients and target markets of such an industry. Agricultural extension, however, differs from industries that manufacture products as their main purpose. Instead, it is an industry that aims to change the behaviors and attitudes of its clients and target markets. It mainly intends to enable its clients and target markets to realize, control, and then implement changes. By so doing, it helps them obtain a sense of satisfaction which comes from their self-realization and achievement.

In addition to the interests of farmers and other target markets, agricultural extension as an industry also involves changes in human beings' attitudes and thinking. It is apparently more difficult to manage the attitudes and thinking of people in an open society than in a closed society. That is because managers or decision-makers cannot enforce a change by merely issuing an executive order simply for their convenience. To be efficient and effective, they must use methods such as extension education, organization, management, and psychology to carry out their policies. This provides a good explanation of why agricultural extension services are gaining more attention in Taiwan's open society.

Background of the Agricultural Extension System in Taiwan

Even though Taiwan is a small country, its economic development is considered that of a newly industrialized nation, while its agricultural sector is classified as that of an advanced nation.

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1 Resource paper presented in the "International Workshop on Agricultural Technology Transfer and Its Consequences" held from 25-30 August 2003, Agricultural Research Institute, Wufeng, Taichung, Taiwan

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Taiwan has reason to be proud of its overall economic performance. Agricultural extension improvement is one of the promising areas. In the past 5 decades, the government agricultural agencies have launched many various strategies and measures to improve our extension system, and the encouraging results have apparently been accepted by the government and the public. Some of what Taiwan has already learned can be useful to other developing countries by allowing them to reduce the costs of trail and error when they face similar stages of economic development.

A country at a different stage in its agricultural development will face different problems. And there is no a panacea for curing these problem. One must observe the paths of others and think about their own specific environments including social, political, and economic resources before adopting various proper measures to deal with them. This is the most appropriate and effective way to follow in the paths of others. There are several major factors which contributed to the development of agriculture in Taiwan, which are described here.

A. Technological innovations

Technological innovations have been a key factor in improving agricultural productivity. In the early stage, emphasis was placed on the development of labor-intensive technologies and biological technologies such as improving crop varieties, applying chemical fertilizers, controlling pests and diseases, and promoting multicropping systems. To cope with rural labor shortages and high wage rates, intensive efforts have been made to develop labor-saving cultivation methods, to speed up farm mechanization, and to promote the use of integrated farming techniques.

B. Farmers' organizations and agricultural extension

There are four kinds of farmer's organizations in Taiwan. The most important one is the farmers' association. Its major services are extension of farm credit, agricultural marketing, and the supply of farm inputs. Other farmers' organizations include irrigation associations, marketing cooperatives, and fisherman's associations. The irrigation associations were organized to operate irrigation facilities and to maintain orderly water distribution.

Most marketing cooperatives in Taiwan are engaged in the marketing of fruit. The fisherman's associations are multiple-purpose cooperative organizations for fishermen. Farm extension services are provided by the farmers' associations in close cooperation with district agricultural improvement stations and agricultural colleges. With the support and guidance of the government, the services of farmers' organizations, including agricultural extension, have greatly improved.

C. Investment in rural infrastructure reconstruction

The objectives of rural infrastructure reconstruction are to provide good working conditions and to efficiently utilize Taiwan's limited land and water resources. Large-scale investment in irrigation and drainage, flood control, soil conservation, land consolidation, farm roads, reforestation, and fishing harbors has not only contributed to increased agricultural output, but has also reduced the damage caused by natural disasters.

D. Provision of modern inputs to the agricultural sector

Modern inputs are required for increasing agricultural production. The major modern inputs include chemical fertilizers, agricultural chemicals, farm machinery, feed, and seeds of improved varieties. The bulk of the chemical fertilizers required for farm production is produced by the Taiwan Fertilizer Co. and distributed through the Provincial Food Bureau. Other inputs are distributed through commercial channels and farmers' associations. Because of advantages of mass production, farmers can obtain these inputs at reasonable prices. To accelerate agricultural mechanization, a subsidy is provided to farmers for purchasing newly developed farm machinery.

E. Improvements in agricultural marketing techniques

The importance of marketing has increased as farm production has become commercially oriented. Major improvement measures include the construction of wholesale markets and marketing facilities, the promotion of cooperative marketing, innovations in grading and packing, the facilitation of marketing transactions and techniques, the establishment of an integrated market information system, and the modernization of the food processing industries.

Extension Organization and System

In Taiwan, the extension system is a unique kind of partnership among the government, farmers' associations (FAs), colleges of agriculture, and farmers, which provides services and education designed to meet the needs of the farmers.

Since 1981, the research/teaching/extension-embodied educational system has been established particularly after extension work from professors of six colleges of agriculture began to participate. The relationship between the colleges of agriculture and the seven District Agricultural Improvement Stations (DAISs) is strong in order to provide better technical support and assistance to county farmers' associations and township farmers' associations as shown in this chart. At present there are extension professors majoring in different agricultural fields from six colleges of agriculture and fishery in Taiwan to provide advisory services to six designated regions. The lectures, visits, technical services, group

discussions, and answer-by-phone services are the most popular tools adopted by extension professors to channel required new skills, knowledge, and concepts to farmers. The District Agricultural Improvement Stations and Agricultural Research Institutions play important roles in providing technical support to this extension work.

The principal governmental organization overseeing agricultural development is the Council of Agriculture (COA) under the Executive Yuan (equivalent to the cabinet of the federal government). Although the Executive Yuan is discussing the possibility of upgrading the COA to a Ministry of Agriculture, within the COA, the Division of Agricultural Extension is responsible for initiating and planning agricultural extension education programs. The DAISs and various Agricultural Experiment Institutes will still play important roles in providing technical know-how and act as constructive units to farmers, as well as extension agents for the FAs.

At the present stage, the main features of extension work in Taiwan can be described as follows.

1. Extension work is carried out by the three levels of farmers' associations, in cooperation with the District Agricultural Improvement Station, and extension professors of colleges of agriculture, under the supervision and guidance of different levels of government.
2. Each township farmers' association (FA) provides extension services to its members in that township. Every farmer can apply for membership regardless of his or her age, sex, race, or business.
3. The scope of the extension service is practically unlimited.
4. All FAs teach and assist farmers in order to improve their livelihoods and to develop the rural economy.
5. The extension work carried out by FAs includes providing practical methods, results, and demonstrations, conducting different farmers' group meetings to provide technical advice, and implementing government-supported projects and services.
6. Funds for extension services come from the previous year's net profits of each FA, i.e., 36% of it. In addition, it is partly funded by the central, provincial, and county governments. But the subsidies are allotted on the basis of special needs arising from certain programs, projects, areas, crops, or other special problems.
7. Funds allotted for the extension service of an FA should not be used for non-educational activities, such as the purchase of souvenirs, agricultural chemicals, etc.

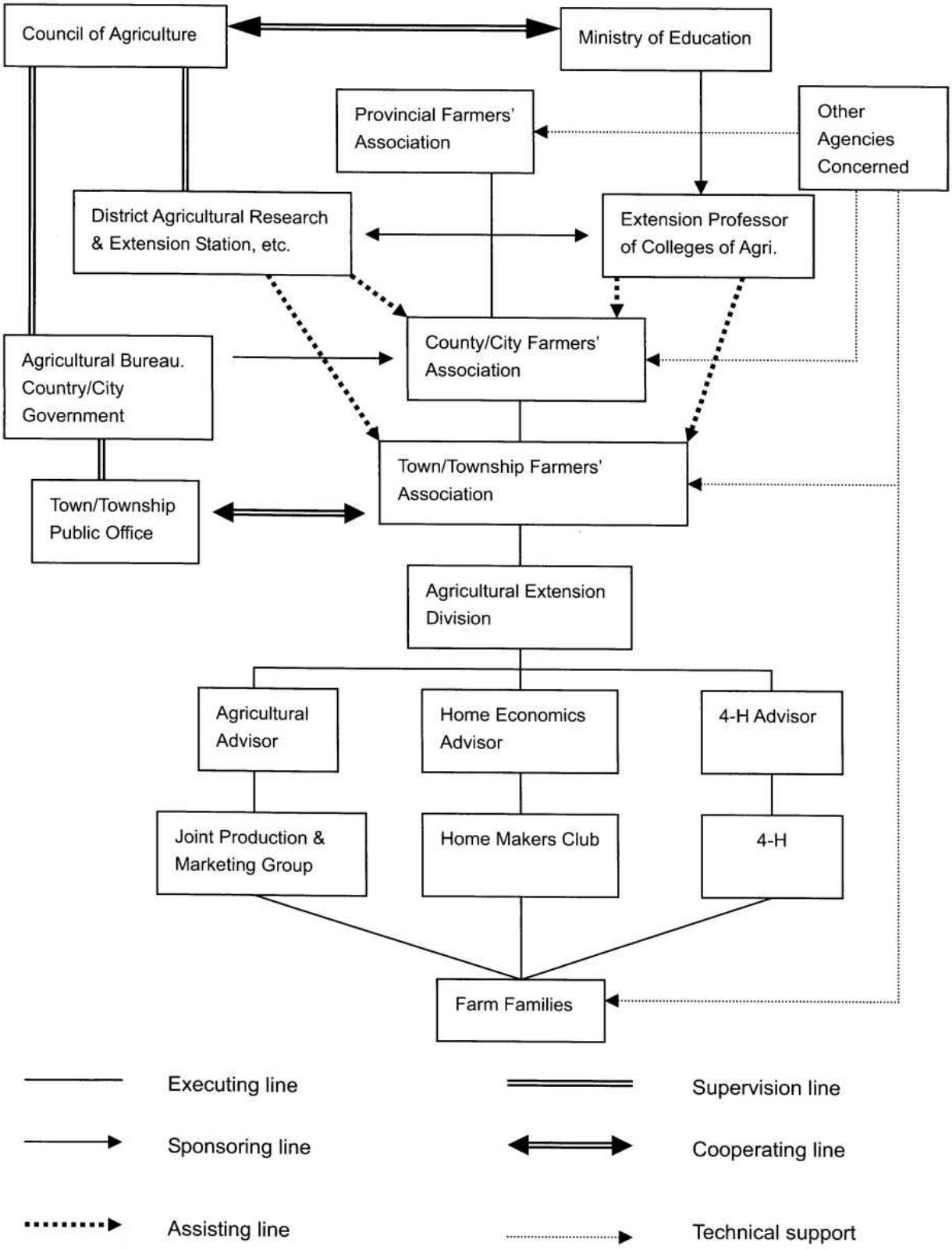

Figure 1. Organizational chart of the agricultural extension system in Taiwan

After 4 decades of interactions with FAs, farmers understand and have adopted modern techniques, and now enjoy their benefits. In Taiwan's case, the evidence is obvious that rapid educational development has played a crucial role in the rapid economic growth achieved.

The problems of the current agricultural extension system in Taiwan can be summarized as follows.

1. Shortage of qualified extension manpower

For years, the revenue of the credit department of FAs has become the major indicator of the success of an FA's management. Extension work has been only part of an FA's business. Unavoidably, the work was not given a high priority among most of their businesses due to the profit-oriented concept of management. According to many studies (e.g., Wu and Tsai, National Taiwan University), more than 60% of extension workers or advisors in FAs devoted only part of their efforts to work directly related to extension. This situation is the same in most District Agricultural Improvement Stations. Researchers and subject matter specialists in the stations tend to confine their interests to research-oriented work. Furthermore, the rate of job change of extension workers in extension-related agencies has been shown as high as 15% annually.

2. Unstable sources of extension finances

In recent years, FAs and other extension-related agencies obtained most of their financial assistance from governmental budgets under various agricultural development projects. On the other hand, the yearly net profits of FAs made available for extension work have declined due to heavy competition in financial markets and inefficiencies of their business. Furthermore, gaps in net profits among FAs have also gradually expanded. The sources of extension finance have become unstable and limited. Therefore, it is very difficult to plan a long-term project especially for agricultural extension work.

3. Abilities to cope with changing agricultural and market environments

The globalization and the free trade of agricultural products, consumer-oriented concepts of production, and management have been considered crucial points of agricultural policy making. Facing the pressure of an open-door policy to international markets, the agricultural sector has already seriously suffered from this pressure. As the agricultural administration has yet to come up with effective policies to handle the situation, how can we expect extension workers to deal with this and help farmers solve these problems. Technology and practices for the adjustment of changing agricultural and economic environments are badly needed in agricultural extension work in the years to come.

4. Restructuring of the Agricultural Extension System

With the streamlining of the Taiwan Provincial Government, the function of the Provincial Department of Agriculture and Forestry (PDAF) will be adjusted; the DAISs and

other Agricultural Experiment Institutes will also be reallocated or consolidated into different sectors of the government. Farmers' associations at various levels are also facing restructuring. Their function and role in providing agricultural financing and agricultural extension are still being actively debated. Whether the Agricultural Extension Act will be submitted to the legislation and how the system should be configured are currently being discussed. Also the decision as to whether there will be a new Ministry of Agriculture established still depends on many uncertain conditions.

A Perspective into the Development of Agricultural Extension

In the face of the changing agricultural strategic environment, we apparently can not ignore future problems if we expect to efficiently achieve the goals of agricultural extension. Although the future is unknown, we can use our perspectives to create some tools which can lead decision-makers and institutions wishing to seek changes to design goals and far-sighted views for organizations and individual farmers. Such an approach will help them go beyond the restraints stemming from traditions, history, and current trends.

A perspective can be defined as a combination of future directions and goals expected from an organization and its members. The value of an organization's perspectives is aimed at providing important guidance for the organization to develop future strategies. Individual perspectives, meanwhile, can serve as a pivotal basis for the development of organizational human resources in the 21st century. Planning, thinking, and the formation of a perspective are indispensable processes for agricultural extension that are based on technologies and their applications. In view of the present and future competitive environments of the agricultural sector, agricultural extension in Taiwan in the 21st century will face the following challenges.

1. There will be limited room for upgrading the competitiveness of agricultural management. Expected effects from measures taken with regard to farmers' services which are mainly designed for cost reductions will weaken.
2. Problems of overlap will emerge between resources of different organizations of farmers' services. The supply will outstrip the demand in organizations and manpower of farmers' services due to decreases in the employed population.
3. Farmers' habits of relying on others will still remain strong. Their sensitivity to rapid changes in the external environment has yet to be improved.
4. Farmers still tend to pay more attention to improving their skills and management abilities, due to the production-oriented policies enforced on them from past services. Their knowledge of democracy, in contrast, is insufficient. Efforts to train

greater numbers of talented people in rural communities, therefore, have yet to be strengthened.

Faced with the unlimited expansion of the information industry and the rapid growth of technology in the 21st century, perspectives embraced for agricultural extension should not just be a reorganization of past visions, a continuation of present goals, or a response to impacts from the outside world. Instead, we must look to the creation of new methods, new knowledge, and new ideas, and then build new structures and perspectives for agricultural extension through the further combining, eliminating, reorganizing, and sharing of resources available in the present.

The focus of the resources and perspectives of Taiwan's district agricultural improvement stations is no longer placed on any single subject or demonstration farm due to changes in the demands of farmers and the market as well as the environment since the 1980s. In addition, the focus of technological innovation, and management and education systems for agricultural extension education is no longer an operation between different subjects. Furthermore, agriculture-related colleges have become a subsystem for agricultural extension education. Because of these factors, the focus of resources and perspectives of district agricultural improvement stations have expanded to cooperation and interaction. Regional agricultural improvement stations should even assume responsibility for the reorganization and integration of the transformation and diffusion of technology newly developed in a district in the face of new challenges and the government's movement for organizational restructuring in the 21st century. They have thus become a new agricultural technology center for applied agricultural science and technology, communications, and human resource development in a district. This is a result of interaction and cooperation between different institutions and systems. The basic structure of a new district agricultural technology center includes the following.

1. It combines agricultural technology, education and training, and communication services in a district into an integrated service.
2. It forms an alliance between agricultural professionals and organizations aimed at organizational and human resource development.
3. It builds a linkage between technology application and evaluation, agricultural technology, communications research and development, and facility planning so as to examine and evaluate related R&D and educational training.
4. It uses cross-agricultural technology strategists as a unit for the formation of perspectives and a structure for arbitration.

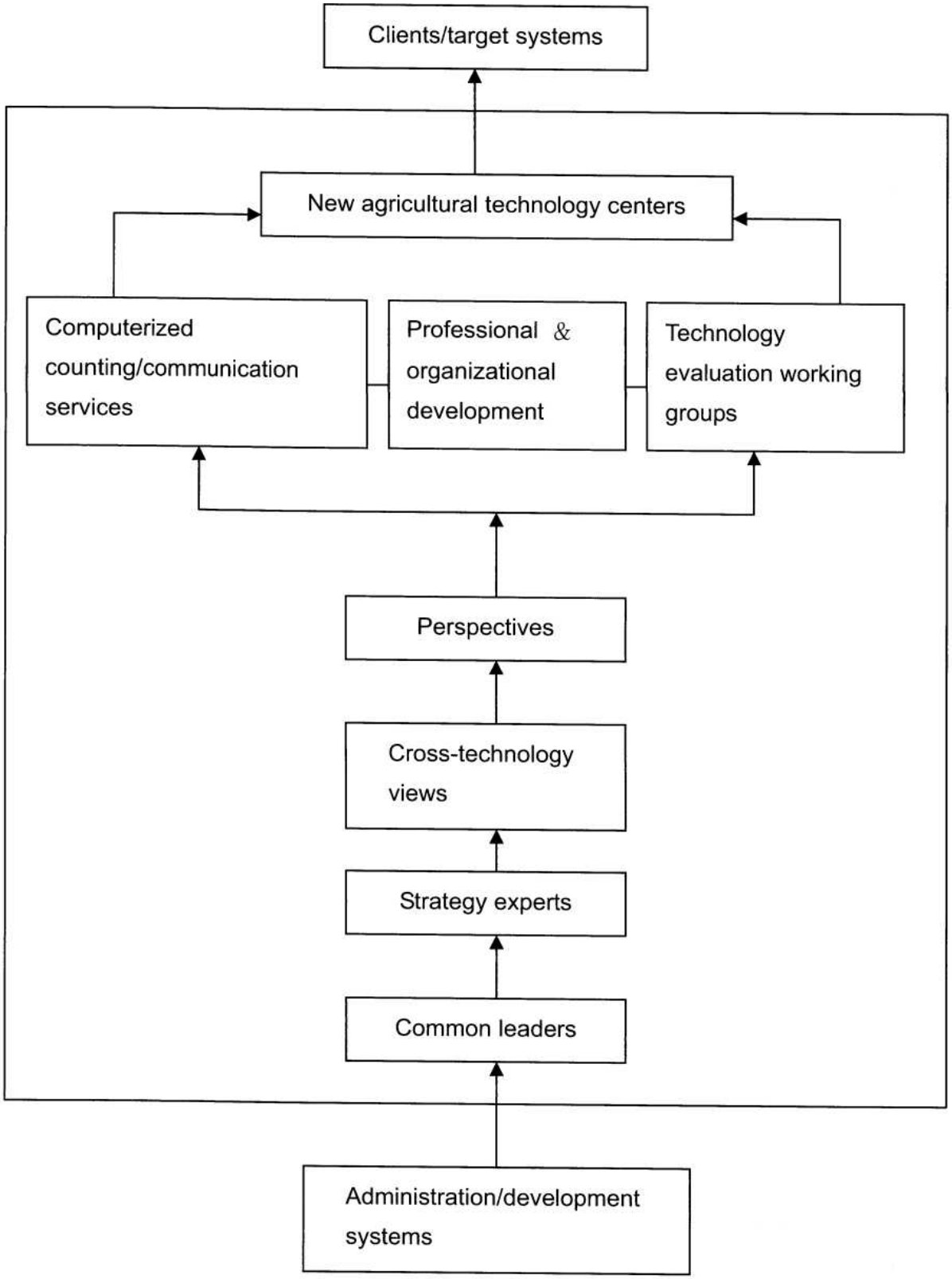

Figure 2. Conceptual structure of a new District Agricultural Technology Center

Figure 2 is a conceptual structure for building a new district agricultural technology center. In the structure, strategists act as a scanning mechanism to inspire innovative ideas and guidance for the future. It is expected to build different environments that can help achieve the goals of agricultural extension.

With her endeavors over more than 4 decades, Taiwan has accumulated many achievements of remarkable agricultural technology research and outstanding agricultural experiment and research talents. These have provided a strong foundation for the continued development of future agriculture in Taiwan. The fruits of agricultural research have come from research efforts of domestic agricultural experimental and improvement institutions, the sharing of other experimental and research results, and the purchase of achievements from domestic and foreign experimental and research institutions. These experimental and research achievements include basic and applied agricultural science and technology as well as humanities and social sciences such as information, management and extension education. Moreover, private research institutions and agri-businesses have made significant contributions to the research and development in this regard and have also achieved remarkable results.

In view of the agricultural technological experimental and research achievements, in fact, Taiwan already has the ability to produce a model for the formation of an agricultural information system. Despite that, those experiment and research achievements have not been integrated together. On top of that, the experimental and research results cannot be directly acquired or used by farmers or agri-businesses. A gap exists between experimental and research results and their applications.

In Taiwan's agricultural information system, there are two missing links which remain to be filled in. One is a mechanism which can form perspectives for farmers' services and then manifest them into goals and strategies. The other is a mechanism that can integrate, eliminate, transform, and diffuse emerging agricultural technologies. These two mechanisms constitute an important part of the infrastructure for agricultural extension. Their implementation will require special people and institutions, if any significant effects in the integration of resources are expected to be achieved.

After building an agricultural information system, therefore, Taiwan still has to plan and build a complete system to implement the program. Based on agricultural knowledge at all levels, the system has to design institutions that can serve to carry out such work as dissemination, management, and services.

free trade system, while conserving their resource base.

As populations rise, along with higher per capita incomes, we can expect the demand for farm commodities to continue to expand in future. Increases in agricultural production can be only be obtained by investing in more farm inputs and by technological improvement. In both Africa and Asia, most farms are fairly small, and there is only limited opportunity to expand the area of available arable land. This puts a constraint on any increase in capital inputs, so that the expansion of agricultural production will depend much more on technological improvement. It is extremely important to speed up the transfer of technology to farmers, by means of regional and international efforts for technology transformation.

I should like to take this opportunity to introduce FFTC. FFTC is a regional agricultural information center, established in 1970. It collects and disseminates research results generated by agricultural institutes in the Asian and Pacific region. The aim is to provide farmers with technical information so that they can achieve higher yields and incomes. Over the last three decades, FFTC has carried out in close cooperation with national and international agricultural agencies in Asia a wide range of programs, including surveys, seminars, workshops, training courses and demonstrations. In the future, FFTC will continue to do its best to promote the exchange and transfer of improved agricultural technologies among the countries in the region, and also between the countries of Africa and Asia. While the cost of air fares is too high for FFTC to include many African participants in its regional programs, we send hundreds of our free publications to African libraries every year. Also, all our recent publications are available free of charge on our website and database.

In the past, I have participated two meetings conducted by AARDO, and I am very pleased to have this opportunity of meeting the Secretary General, Dr. Munip again. I should like to extend my heartfelt appreciation to COA and TARI for all the support and cooperation you have given FFTC. Finally, I wish this Workshop every success, and I hope the participants from abroad may have a pleasant time during your stay in this beautiful island of Taiwan.

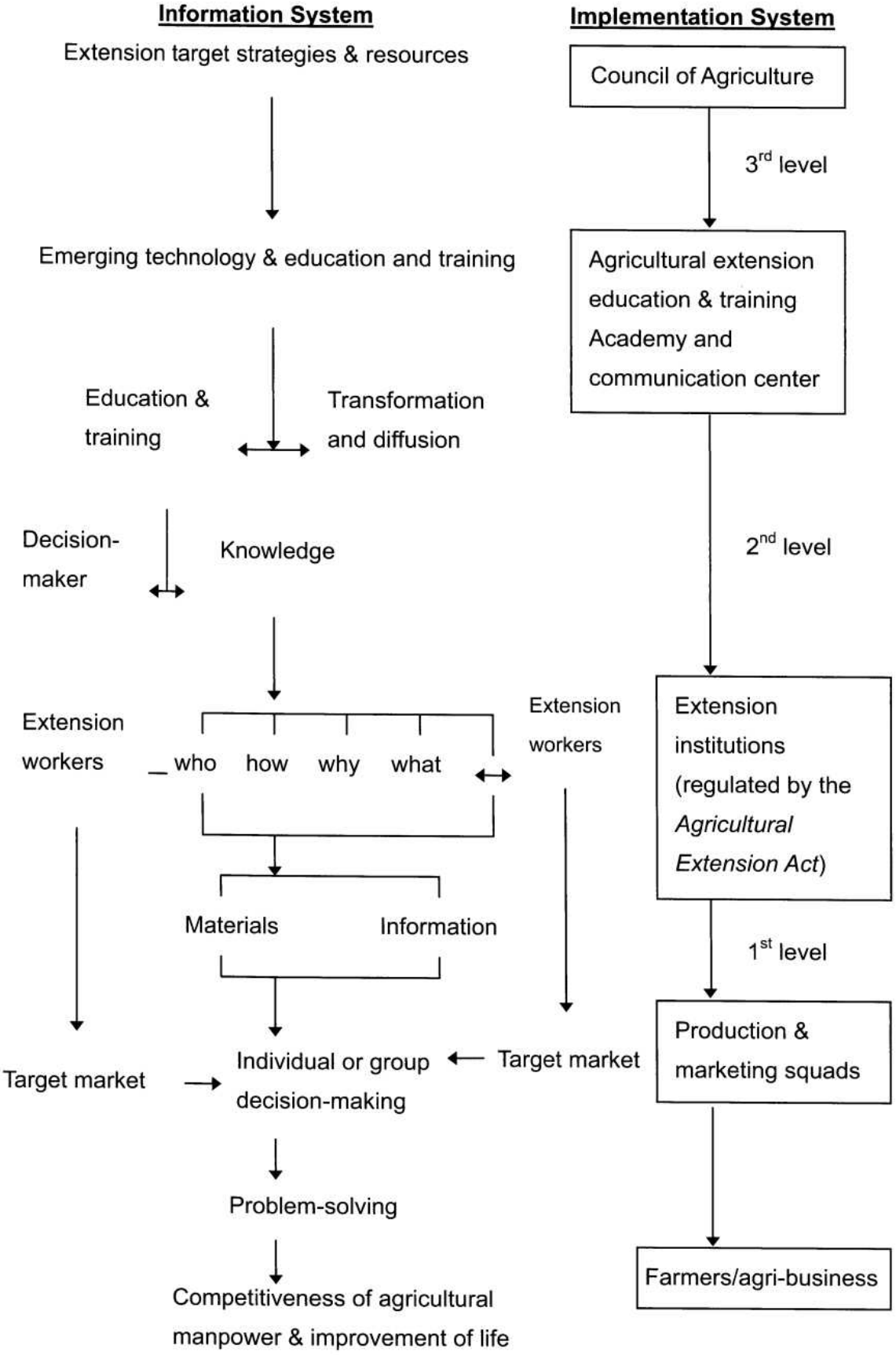

Fig. 3. An integrated structure of the agricultural extension information system

Figure 3 is a conceptual structure for building an integrated system for agricultural extension in Taiwan. This structural chart includes an information system for agricultural extension and an implementation system. The information system includes goals, strategies, and resources, emerging technology and education and training, transformation and diffusion of emerging agricultural technology, knowledge (know how, know who, know why, and know what), materials, and information. The Council of Agriculture act as the implementation system in response to the information system of extension goals, strategies, and resources.

The implementation system for the transformation and diffusion of emerging technologies and education and training is formed by the Agricultural Extension Education and Training Academy and is an affiliated communication center. It is placed in the center between the agricultural extension information system and the implementation system, under the direct jurisdiction of the Council of Agriculture. District agricultural improvement stations and agricultural skill and art centers form its branches. According to the planning of this academy and center, it will be in charge of professional education and training and technology dissemination. It will also be responsible for the transformation and dissemination of emerging agricultural technologies as well as related education and training.

Conclusions

Traditionally, agricultural extension has mostly been focused on the accumulation of economic capital and the enrichment of life. As a result, the accumulation of cultural and natural capital has been overlooked. The first formula for a mature industry that will adapt itself to changes is to provide products and services at the demand of its clients and respond swiftly to changing situations. The second formula is to produce required products and services at delivery points and make every effort to move production sites to places close to clients so as to gain more competitive predominance. To provide services or higher standards and quality, however, it will have to rely on computerized networking of information that is available for direct saving and retrieval of data. The networking of organizations, enterprises, and extension institutions, and the integration of their coordination, cooperation, and collaboration, therefore, have become the third formula for a mature industry that is to adapt itself to changing environments.

In the face of changing strategic environments in the 21st century, an industry should strive for sustainable growth as a primary consideration of its goals and use different methods of integration to seek and utilize resources. Meanwhile, the government should play a role in creating and providing good opportunities and conditions for the development of organizations and individuals.

Agricultural extension is an industry that manages changes. The government and extension institutions must not shirk their responsibilities in this regard to manage this industry well. In the global village of this new century, agricultural extension should be directed at building and diffusing an information system featuring culture, humanities, and nature. Agricultural extension must be closely linked with ecosystems and society. We should first begin by identifying ourselves with our own society and through further exploration of our lives, culture, and environment, in order to build a personality of Taiwan for the new century that boasts of selfconfidence and true love.

Most of all, we must go beyond traditional thinking and ponder problems with an open mind for global development as a whole.

Inaugural Address

H.E. Dr. Bahar Munip

Secretary General, AARDO

H. E. Mr. Ming-Lai Wang, Director General, Council of Agriculture, Dr. Chien-Yih, Lin, Director General, TARI, Dr. Torng-Chuang Wu, Director General, FFTC, Dr. Tom Lumpkin, Director General , AVRDC

Distinguished Guests, Participants, Ladies and Gentlemen,

It is wonderful to be back here and meet some old colleagues and friends in this beautiful country. When Mr. James Lee, the Deputy Director General, Department of International Cooperation, Council of Agriculture, mentioned to me last June in Delhi, during the 51st Session of AARDO Executive Committee meeting and expressed that the Council was keen to organize this international workshop I was rather apprehensive of its out come. In June 2003, the gigantic shadow of SARS was still lingering menacingly over the region. AARDO was offered 30 places for this workshop and we were wondering whether there would be enough response from member countries. At first response was very slow as member countries were adopting "wait-and-see" attitude. It is only after extending the date line to the 5th of August that the response was overwhelming and we have to refuse, due to logistic reason, quite a number of applications. We have therefore, here participants from Ghana, India, Japan, Republic of Korea, Malaysia, Mauritius, Oman, the Philippines and Syria – not to mention the host country, Republic of China. I have just noticed there were two other countries as well – Grenada and Indonesia. To all of you welcome to the international workshop.

I have also just been informed on my arrival that Mr. James Lee has had a major surgery and that he is now on the road to recovery. We wish him good health and a speedy recovery.

The agriculture sector has never been challenged as it is today brought about by WTO. Only the most efficient and productive could survive. Faced with these challenges some countries have invested considerably in research and development. The question remains on how to transfer this technology to the target groups namely the farmers. Various learned speakers before we have all emphasized the importance of this transfer and its is not possible for me to emphasize it further.

I was, therefore, very happy indeed when Republic of China came forward offering to organise this international workshop in collaboration with AARDO. In the next few days we shall be discussing approaches and methodologies of technology transfer and the experiences of various countries. I take this opportunity to thank the Government of the Republic of China and the Council of Agriculture, Executive Yuan for organising this important workshop.

The Republic of China has always been in the forefront in AARDO's endeavour to increase the number of inter-governmental collaborations in the sphere of rural development-not only in terms of HRD such as this one, but also in development projects on the ground. The following are but a few examples of this collaboration:

i) For HRD, apart from the international workshop that is being held today and the next six days, two other workshops were held during the last three years. This current international workshop is the third in the series of international workshop/seminar being hosted by Republic of China. The other two successful international workshops were on "Establishment of Marketing and Extension of Farm Produce" in 2000 and on "Challenges to Agriculture in the New Millennium" in the subsequent year, i.e., 2001. Thirty nine (39) participants from AARDO member countries attended these two workshops.

ii) The Republic of China provides fully paid fellowships to the participants from member countries. During the last 5 years, some 44 officers from AARDO member counties have participated in training programmes in various centres of excellence in Republic of China, which included: i) International Centre for Land Policy Studies Training at Taoyoun; ii) Asian Vegetable Research & Development Centre, Tainan; iii) Taiwan Fishery Research Institute; and iv) The Tissue Culture Training Centre.

iii) AARDO has also facilitated experts from member countries to visit Republic of China and enabled them to study and observe the technological advancements made in Republic of China under its "Study Visit Programme".

iv) Since 1997, 10 experts and specialists from member countries visited Republic of China to study and observe agricultural development activities. These study visits gave good exposures to the visiting experts/specialists on the developmental practices followed by Republic of China. It is hoped that such visits will bring Republic of China more closer to other AARDO member countries and facilitate transfer of technology in the field of agriculture and other aspects of rural development.

v) AARDO in its turn has encouraged participants from Republic of China in international seminars and workshops held in other member counties. In the last six years, nine international workshops/seminars had been held in member countries. These are: "Micro Entrepreneurship Development for Rural Women" in Malaysia (1998); "People's Participation

in Rural Development" in Ghana (1998); "Integrated Gender Issues in Rural Development Projects" in Jordan (1999); "Promotion of Agri-business to Enhance the Income of Farm Households" in Egypt (2000); "Strategies in Developing a Modern and Efficient Food Crops Sector" in Malaysia (2001); "Income Generating Activities for Rural Families: Identification, Planning and Implementation" in Jordan (2001); "Challenges to Small-holders Sectors Towards Globalisation" in Malaysia (2002); "Poverty Alleviation Through Micro Finance : Potentials and Constraints" in Malaysia (2002); and "Sustainable Farming-Ensuring Food Safety and Environmental Quality" in Malaysia (2003). Some twenty (20) participants/resource persons from Republic of China had attended these workshops/seminars including those conducted in Japan under our "Research and Education Centre" (RECA) of AARDO.

vi) The Republic of China has also participated in our development pilot projects held on the ground in situ in member counties. At the request of AARDO, the Government of Republic of China also provided additional financial assistance to the tune of more than US $30,000 for the implementation of an AARDO's rural development project on "Production of Medicinal Herbs Agro-Enterprises" in Jordan. In fact, His Excellency Mr. K.T. Chien, Director General, Taipei Economic and Cultural Centre, New Delhi, had visited the project in 2001.

vii) The Republic of China has also voluntarily increased its annual membership contribution to AARDO to US $60,000 with effect from 2001.

viii) I am happy to note that in response to the continues support and cooperation extended by the Republic of China to the Organization over the years, AARDO member countries during its 13th Conference held in New Delhi in January 2000 had unanimously elected Republic of China to be its Vice-President for Asia for the triennium 2000-2002. The 14th AARDO Conference held in Cairo in September 2002 had also elected the Republic of China to be a member of its governing council for the triennium 2003-2005.

I would have failed in my duty had I not taken the opportunity to thank the Organising Committee for the excellent arrangements made in organising this workshop. Thanks are due to Dr. Chien-Yih Lin, the Director General of TARI and his officials for hosting the workshop here in TARI. I am afraid I shall miss his farewell dinner on 30th August 2003 at the Tong Hai Fish Village Restaurant. I am sure the food would be very delicious. My thanks are also due to Dr. Sheng-Cheng Huang, the Scientific Secretary of the international workshop and his team, who worked very hard to make the workshop a success.

The credit for organising this workshop definitely goes to my counterpart at the Council of Agriculture, Executive Yuan – The Director General, H.E. Mr. Ming-Lai Wang and his wonderful team, especially in such a short notice which was not possible but for their willing cooperation and timely help. I am fully aware of the difficulties faced in organising such a

programme, the inevitable changes, the last minute cancellation, etc. that frequently occur.

I would like to take this opportunity to congratulate Dr. Su-San Chang who I believe would be leaving soon to serve in the Republic of China Mission in Geneva-Mission to WTO. Dr. Su-San has a deep knowledge about WTO and its implications and on many occasions I have learnt quite a lot from her.

Finally, we in AARDO are looking forward to the useful outcome and recommendations that will emerge from this workshop. During the six days period participants will have the opportunity to interact with each other and develop networking that will be useful to them in the performance of their responsibilities back home.

Thanks for your attention.

Expert Papers

AARDO International Workshop (2003)
Agricultural Technology Transfer and Its Consequences
1-22

Technology Transfer for Rural Development: Personal and Social Communication Perspectives[1]

Tricia R. Javier[2]

ABSTRACT

Technology transfer doesn't happen in a vacuum. Internal and external factors influence technology transfer before development can happen. This paper discusses the factors that affect technology transfer from the point of view of the individual and society. Concepts related to technology transfer are discussed, among these are: development, social change, participation, communication and some technology transfer mechanisms.

This paper discusses technology transfer based on two communication theories: Reciprocal Determinism Theory (Bandura 1996) and Communication for Social Change Model (Figueroa and Kincaid 2002).

Bandura's Reciprocal Determinism Theory maintains that human development reflects interaction among an active person and the person's behavior, and the environment. The links among these three are interactional, i.e., they flow in both directions. This theory was tested and was proven applicable in a participatory development project (Javier 1997).

The Communication for Social Change Model describes how social change (development) can happen through a process of community dialogue leading to a collective action that affects the welfare of communities as a whole, as well as, individual member. The theory is descriptive, as well as, prescriptive.

The technology transfer mechanisms discussed are Technology Assessment, Farmers' Information and Technology Services, Farmer-Scientist Bureau, Regional Applied Communication Office, and Information and Communications Technology.

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1 Paper presented during the "International Workshop on Agricultural Technology Transfer and its Consequences" held from 25-30 August 2003, Agricultural Research Institute, Wufeng, Taichung, Taiwan.

2 Supervising Science Research Specialist, Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Department of Science and Technology, Los Baños, Laguna, 4030 Philippines.

Introduction

Technology transfer doesn't happen in a vacuum. Internal and external factors influence technology transfer before development can happen. This paper discusses the factors that affect technology transfer from the point of view of the individual and society. Concepts related to technology transfer will be elucidated. Among these are the concepts of development, social change, participation, communication, and some technology transfer mechanisms.

This paper discusses technology transfer based on the Reciprocal Determinism Theory (Bandura 1996) and the Communication for Social Change Model (Figueroa and Kincaid 2002).

The premise of this paper is that technology transfer leads to rural development. Development is a process of social change. It involves improvement in factors, which affect the standard of living and quality of life of the people. Development affects three major areas of change: environmental (access and use of natural resources, education, health, and social status), economic (production or income, technological, access to the factors of production, etc.), and political (power, control, access, leadership, equity, and distribution of benefits) (Natpracha and Stephens 1991).

Bandura's Reciprocal Determinism theory maintains that human development reflects interaction among an active person and the person's behavior, and the environment. The links among these three are interactional i.e., they flow in both directions. Therefore, we both are shaped by our environment and shape it. (Shaffer 1996).

Social change is an ongoing process that can be spontaneous or purposeful. The Communication for Social Change Model describes how social change can happen through a process of community dialogue leading to a collective action that affects the welfare of communities as a whole, as well as, individual members.

Participation is a process by which people become involved at all stages in their development, studying their own situation and making decisions in: research, planning, implementing and managing, monitoring and evaluating, and deciding on the distribution of benefits to ensure equitable sharing (Natpracha and Stephens 1991).

The importance of communication in development saw its beginnings in the work of Paulo Freire (1970) who conceived of communication as dialogue and participation for the purpose of creating cultural identity, trust, commitment, ownership, and empowerment (Figueroa 2002). There is a widespread awareness in the field of development communication that community participation is a valuable end in itself as well as a means to a better life.

What is Technology Transfer?

The dictionary defined technology as the application of scientific knowledge for practical purposes (Jewell and Abate 2001). Caoyonan (1994) defined it as the application of scientific or theoretical know how for practical purposes. It is the means by which man improves his life through the centuries.

The dictionary defined technology transfer as the transfer of new technology from the originator to a secondary user, especially from developed to less developed countries in an attempt to boost their economies (Jewell and Abate 2001). Caoyonan (1994) defined it as the dynamic transfer of technology, which involves the development of skills, knowledge, and experience of the recipient so he can acquire an autonomous capacity to implement technical changes and/or build new facilities.

Classification of Technologies (PCARRD 2001)

Technologies may be classified as follows:

- Product – This type of technology takes the form of physical goods. Examples are farm equipment and machinery, new crop varieties and hybrids, feed formulations, etc. These technologies are normally directed toward a specific market demand.
- Process – Technologies of this nature are not tangible and may refer to systems for doing things or systems for improved production and postproduction. These may also involve models or strategies for efficient utilization, conservation, and management of resources; marketing and distribution system; seed production system, and others. In general, they are aimed at increasing productivity and efficiency but cannot by themselves create a market for their use. Examples are biological method of coconut oil extraction, farming systems for small hold upland farmers and village-level coconut processing.
- Service – This type of technology generally provides the complementary activities or services to enhance existing government programs and policies. Technologies under this category may necessitate government support especially in the early stages where market structure may not yet provide adequate premium to encourage payoff to private investments. For instance, estrus synchronization and artificial insemination to improve Philippine buffalo.
- Information – Other technologies are simply information or research findings that may indicate valuable socioeconomic and technical databases for policy formulation and follow-up R&D activities. These may also refer to computer aided information systems in support of agricultural production.

Methods of Technology Transfer (Viloria 1977)

Technology may be transferred as follows:

- Direct investment in a subsidiary, joint venture or other type of enterprise.
- Direct purchase of operative technology like the purchase of equipment or the employment of a consultant.
- Management contracts of varying scope and duration and covering pre-investment and post-investment services and the management of enterprises.
- License agreements concerning know-how, patents, trademarks, and designs, etc.
- Turn-key contracts.
- Efficient dissemination and utilization of published technological information.
- Training of personnel at research and development institutes/laboratories in developed countries.

Unsuccessful technology transfer (Viloria 1977)

Technology transfer may not be successful due to the following:

- Technology is too advanced or not adapted to the country.
- Differences in the labor Vs. capital factors found in the developing and developed economies are not given consideration.
- Inadequate infrastructure, insufficient trained manpower, inadequate markets, or other social, cultural or economic barriers to high technology transfer.
- Technology is not in keeping with national development goals.

Criteria in selecting appropriate technology (Viloria 1977)

Appropriate technology is that level of technology, which is best suited to the specific cultural, economic, social, environmental, and political climate found in the various countries of the world. The following are the criteria in selecting appropriate technology:

- Technology is seldom directly transferable. More often than not it must be adapted to different environmental conditions. For example, dry-land rice harvesting machinery will not work in a wetland rice growing country.
- The various cultural, political, economic and infrastructure conditions must be considered in suggesting the appropriate technology. For example, a high electric power-using technology would be inappropriate for an area devoid of reliable electric power.
- To the maximum extent possible local materials and natural manpower and man-made resources should be utilized.
- Appropriate technology should encourage and foster indigenous initiative and innovation. It is not sufficient to buy technology and know-how and transfer and install

it without encouraging in the productive system flexibility and a willingness to change with changing markets and other factors.

- Appropriate technologies must have or develop logistical support systems, such as maintenance services and spare parts availability.

Characteristics of technology (Reyes 1993)

Certain attributes of a technology facilitate its adoption:

- Relative comparative advantage (over an existing technology) in terms of lower cost, lower risk, higher economic returns, and technical superiority.
- Compatibility with an existing norm or practice.
- Ease or simplicity of application or use with less mental or physical effort from the adopters.
- Replicability or ease of replicating the technology in the client's situation.
- Observability or demonstrability in terms of outputs of results being readily observable with not much waiting time.
- Reliability in terms of promised outputs or results being achieved or observed as specified.
- Environment-friendly.

Theoretical Framework

Technology transfer happens in a social context. Individuals make technology transfer possible. The theory on Reciprocal Determinism analyzes technology transfer from a personal point of view. Society is made up of individuals, which make technology transfer possible. The theory on Social Communication for Social Change analyzes technology transfer from a societal point of view. The theories are descriptive but are also prescriptive. The theories describe and prescribe mechanisms on how to effectively transfer technology.

Personal Communication Model

Aggression on television is related to violence (APA 2003)

Aggression is related to watching television. Specifically, children who watch violence on television grow up to be aggressive adults. As early as 1963, Bandura suggested that children's imitation of aggressive acts seen in films suggests that we might learn aggression by watching violence on television.

- Berkowitz (1974) studied a group of boys when they were 9 years old. Ten years later he found out that those boys who watched the most violence on television were the most aggressive when they were 19.
- Philips (1983) reported that the number of homicides in the United States significantly increased after championship boxing matches was aired on television.
- Huesmann and Eron (1986) studied 758 subjects. The researchers found positive correlations between overall television violence viewing and aggression in all grades in the United States.
- Eron and his associates at the University of Illinois confirmed that children who watched many hours of television violence when they were in elementary school tended to also show a higher level of aggressive behavior when they became teenagers. By observing these youngsters until they were 30 years old, Eron found that the ones who watched a lot of television when they were 8 years old were more likely to be arrested and prosecuted for criminal acts as adults.
- In 1982, the National Institute of Mental Health in the US confirmed that violent programs on television lead to aggressive behavior by children and teenagers who watch those programs.

Communication is related to Participation in Development

The negative effects of media cannot be underestimated. While the negative effects of media have been studied extensively, very few studies have been conducted to prove the positive effects of media. The author (Javier 1997) conducted a study to determine the relationships of communication, participation, and personal social cognition. The author wanted to prove that rural development might be achieved given internal and external stimuli. The author proved that positive communication could lead to positive action.

Reciprocal Determinism Theory

Human functioning is a result of the continuous reciprocal interaction of behavioral, personal, and environmental influences, called reciprocal determinism. Human behavior is a triadic, dynamic, and a reciprocal interaction of personal factors, behavior, and the environment (Bandura 1977, 1986, 1989 in Figueroa et al 2002).

Bandura's triadic model of reciprocal determinism indicates that while behavior is influenced by the environment, the environment is also partly a product of a person's own making, so that people can exercise some influence over their own behavior. Bandura also argues that because of their extraordinary capacity to use symbols, human beings are able to think, create and plan cognitive processes that are constantly revealed through overt actions.

Each of the three variables in the reciprocal determinism model is capable of influencing each of the other variables (Hjelle1992).

According to this theory, an individual's behavior is uniquely determined by each of there three factors. Emphasizing on cognition, this suggests that the mind is an active force that constructs one's reality, selectively encodes information, performs behavior on the basis of values and expectations, and imposes structure on its own actions (Jones, 1989). Through feedback and reciprocity, a person's own reality is formed by the interaction of the environment and one's cognitions. It is through an understanding of the processes involved in one's construction of reality that enables human behavior to be understood, predicted, and changed.

On the question, "Which of the three parts of the model will influence which other part?" this mainly depends on the strength of each of the variables (Hjelle1992). Hjelle adds that social cognitive theory subscribes to a model of reciprocal causation in which cognitive, affective, and other personal factors, and environmental events all operate as interacting determinants.

The person-behavior interaction involves the bi-directional influences of one's thoughts, emotions, and biological properties and one's actions (Bandura, 1977, 1986, 1989 in Figueroa et al 2002). For example, a person's expectations, beliefs, self-perceptions, goals, and intentions give shape and direction to behavior. However, the behavior that is carried out will then affect one's thoughts and emotions. Biological factors are also accounted for, such as sex, ethnicity, temperament, and genetic predisposition and the influences they have on behavior.

A bi-directional interaction also occurs between the environment and personal characteristics. In this process, human expectations, beliefs, and cognitive competencies are developed and modified by social influences and physical structures within the environment. These social influences can convey information and activate emotional reactions through such factors as modeling, instruction, and social persuasion. In addition, humans evoke different reactions from their social environment as a result of their physical characteristics, such as age, size, race, sex, physical attractiveness.

The final interaction occurs between behavior and the environment. Bandura contends that people are both products and producers of their environment. A person's behavior will determine the aspects of their environment to which they are exposed, and behavior is, in turn, modified by that environment. A person's behavior can affect the way in which they experience the environment through selective attention. Based on learned human preferences and competencies, humans select whom they interact with and the activities they participate in from a vast range of possibilities. Human behavior also influences their environment, such as when an aggressive person creates a hostile environment. Thus, behavior determines which of the many potential environmental influences come into play and

what forms they will take. In turn, the environment partly determines which forms of ones behavior are developed and activated.

Bandura suggests that it is symbols that serve as the mechanism for thought. Through the formation of symbols, such as images (mental pictures) or words, humans are able to give meaning, form, and contiguity to their experiences. In addition, the capability to form symbols enables humans to store information in their memory that can be used to guide future behaviors. It is through this process that humans are able to model observed behavior.

Symbols provide the mechanism that allows for cognitive problem solving and engaging in foresightful action. It is through foresight that one can think through the consequences of a behavior without actually performing the behavior. Research indicates that indeed much of human thought is linguistically based, and that there is a correlation between cognitive development and language acquisition.

Conceptual Framework

A study was conducted by this author on Personal Social Cognition, Communication, and Participation in an Agricultural Resources Management Program (1997). The study tried to prove that human functioning might be determined by the interaction of three variables, personal social cognition, communication, and participation (Figure 2). This was based on Bandura's reciprocal determinism model as shown in Figure 1. Following Bandura's model, personal social cognition was considered as a personal factor; communication was considered as an external factor due to outside stimuli (other individuals, and mediated strategies); and participation was considered as an overt behavior.

Specifically, this research assessed the effects of personal social cognition and how it is affected by communication and participation in a participatory R&D project. Personal social cognition referred to the structure or schema (people, event, role, self schema) and attribution (internal or external; controllable or uncontrollable; and stable or unstable) of individuals.

Participation referred to the individual's planning, decision-making, implementation, research designing, monitoring and evaluation, policy-making, etc., activities of the FARM Sub-Programme on Asian Biotechnology and Biodiversity (ABB). Participation was predicted to affect and be affected by personal social cognition, and communication.

Communication, on the other hand, referred to the individual, group, and mediated communication strategies. This study assessed the effects of communication in participation and personal social cognition.

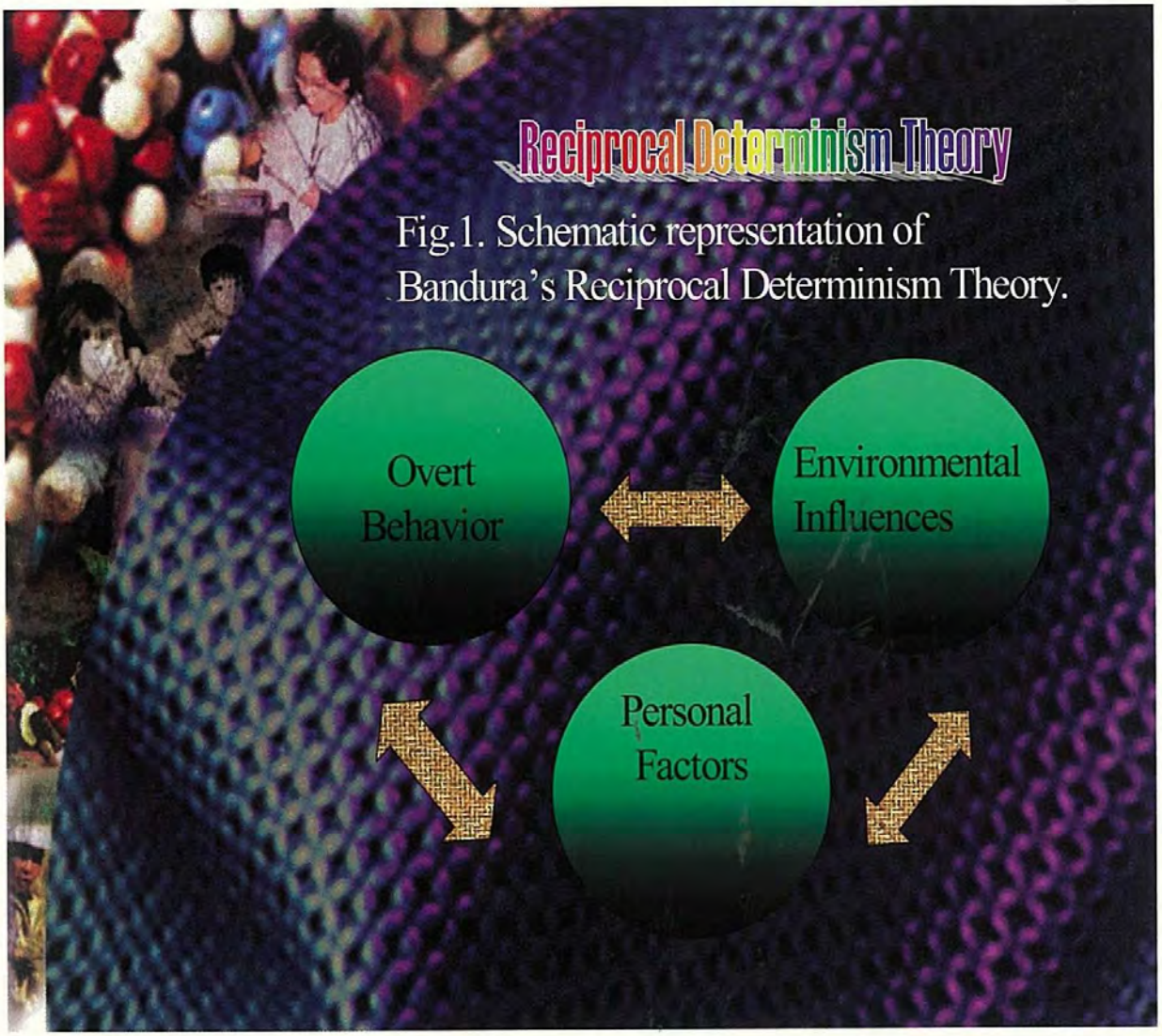

Figure 1. Schematic representation of Bandura's reciprocal determinism model (Adopted from Bandura 1989 in Hjelle 1992).

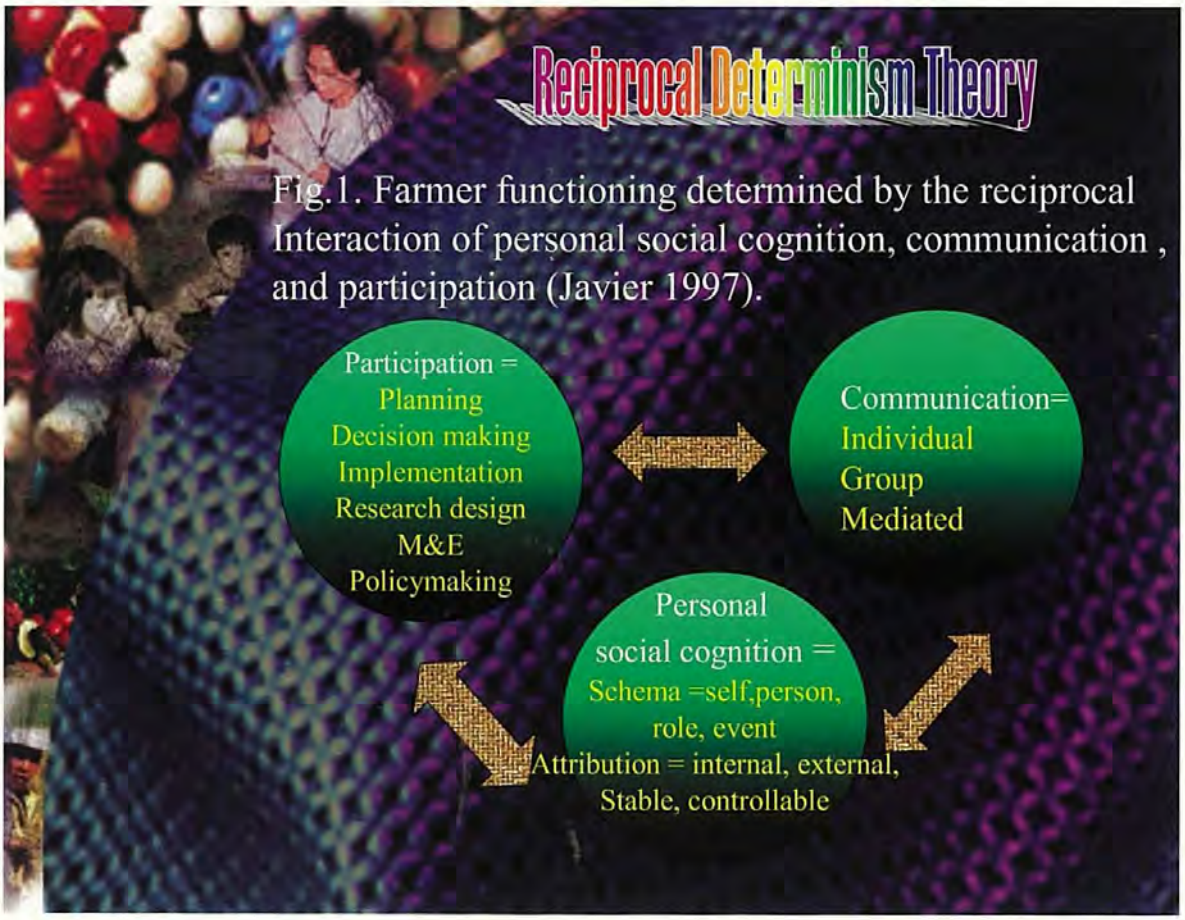

Figure 2. Farmer functioning determined by the reciprocal interaction of personal social cognition, communication, and participation (Javier 1997).

This study proved that this conceptual framework is workable and applicable in the FARM Programme in Infanta, Quezon.

The conceptual framework based on the reciprocal determinism model of Bandura, proved to be workable in this study. According to Bandura, human functioning is a result of the continuous reciprocal interaction of behavioral, personal, and environmental influences (Bandura in Hjelle, 1992). This study proved that farmer functioning is a result of the continuous reciprocal interaction of personal social cognition, communication, and participation. Results revealed the importance of cognitive factors like schema (including events, roles, self-schema, and other persons) and attributions in personal social cognition. It is also implied that different communication strategies like individual, group, and mediated must be used in order to achieve a high level of communication. Additionally, R&D programs

are advised to apply the participatory approach (from planning, decision-making, implementation, policy-making, monitoring and evaluation, research design, etc.) in order to achieve a high level of participation from members.

These findings indicate that the FARM Programme needs to strengthen the capabilities of farmer-participants to understand themselves, the other participants, and their environment so that participants may be able to predict and control the Programme's directions. The communication component must also be strengthened as it affects the participatory behavior of the respondents. All in all, sustainability of the FARM Proramme may be achieved if the three components (personal social cognition, communication, and, participation) will be strengthened and sustained.

Social Communication Model

Communication for social change model

The model of Communication for Social Change (CFSC) (Figueroa 2002) describes a process where "community dialogue" and "collective action" work together to produce social change in a community that improves the welfare of members. The model describes a dynamic, iterative process that starts with a catalyst/stimulus that can be external or internal to the community. This catalyst leads to dialogue within the community that when effective, leads to collective action and the resolution of a common problem.

The catalyst represents the trigger that initiates the community dialogue about a specific issue of concern or interest to the community. This catalyst is a missing piece in most of the literature about development communication. Some type of catalyst is necessary to stimulate a community to consider and discuss a problem.

Six potential catalysts:

1. Internal stimulus – problem in the community.
2. Change agent – induces the community to take some type of collective action.
3. Innovation – availability of new invention, may stimulate a community to talk about its adoption.
4. Policies – prompt the community to act.
5. Technology – may stimulate the community to talk.
6. Mass media – include messages designed to promote individual behavior or collective action, may stimulate members of the community to adopt the behavior or to emulate other communities that have achieved some common goal by working together.

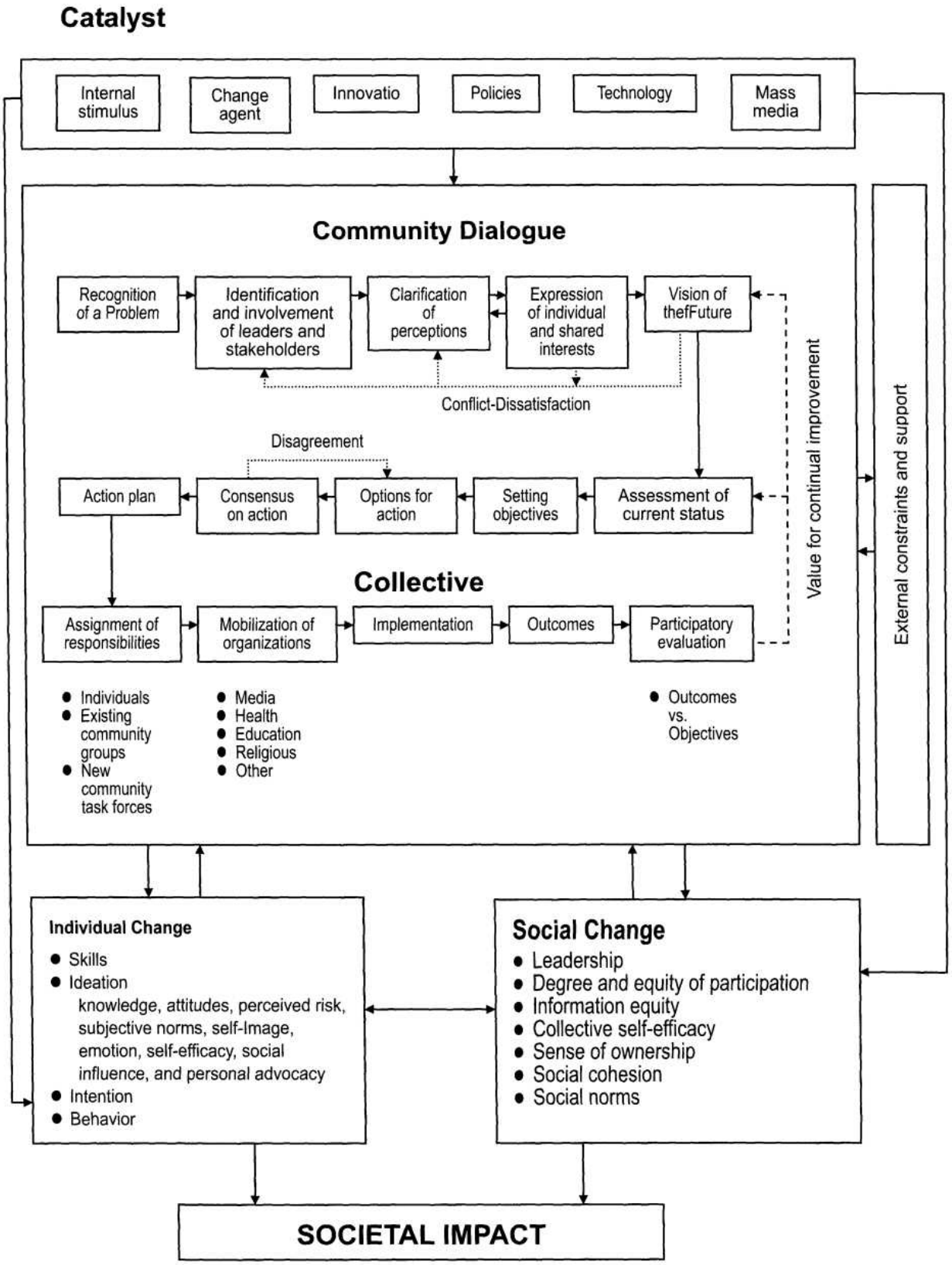

Figure 3. Integrated model of communication for social change (Figueroa and Kincaid 2002).

Community dialogue and action describes a sequential process or series of steps that can take place within the community, some of them simultaneously, and which lead to a solution to a common problem. Previous experience and literature indicate that if these steps are successfully completed, community action is more likely to be successful.

The 10 steps of community dialogue are:

1. Recognition of a problem – As a result of a catalyst, someone in the community becomes aware of the existence of a problem.

2. Identification and involvement of leaders and stakeholders – Someone exercises leadership and takes responsibility for solving the problem. The leader identifies other opinion leaders and resource persons who can help in the process for solving the problem.

3. Clarification of perceptions – It is possible that different perceptions of the problem exist among different members of the community. Unless a consensus can be reached regarding the nature of the problem and its causes, it will be difficult for the group to find an adequate course of action that is acceptable to everyone. Dialogue is necessary to create a mutual understanding (common framework) with which to solve the problem. Only after such perceptions have been clarified and different points of view rectified can the process move forward with a clear understanding of how the problem should be addressed.

4. Expression of individual and shared needs – Involve individuals that are among the most disadvantaged. Not everyone will experience the problem with the same severity. It is important that all affected in the community get the chance to express their own views and needs. If any conflict or dissatisfaction arises, then community leaders have to resolve the conflict before much progress can be made with the problem.

5. Vision of the future – The 'ideal' picture of how the community wants to see itself in the future. This will be the answer to the question: "Where do we want to be in a year from now, with respect to the problem?" It is important that this vision involves representatives of all affected groups (stakeholders) in the community so that it becomes inclusive of all interests. The common vision expresses all of the changes that will occur and the benefits that everyone expects to receive.

6. Assessment of current status – Assessment of status tells them where they are now. Quantification of the problem will give a clear idea of the size of the problem. Qualitative assessment would consider what kind of problem is occurring and how it

differs from previous experiences. Unless a clear measure of the problem is established it will be difficult to set goals for action, and determine if any progress is being made.

7. Setting objectives – The act of comparing one's current status with one's desired status and then setting realistic goals is the source of group motivation. Moderate goal setting that is achievable creates the high level of group motivation that is required for people to take sufficient action to solve a problem.

8. Options for action – Implies the identification of resources both inside and outside the community as well as persons or groups that can carry them out. A sufficient consensus for action must be reached to avoid conflict.

9. Consensus on action – Once a detailed plan is at hand, a new process of getting consensus among the community needs to take place. Getting consensus is important not only for summing up resources but also for getting people to volunteer for assigning courses of action to various members of the community. The more the community participates and sees the proposed actions as 'theirs', the more likely that they will take action. Likewise, the more a community is 'involved and committed' the higher the empowerment and sense of collective self-efficacy that the community will develop.

10. Action plan – A specific timetable for when each activity has to be accomplished will help the community to have clear deadlines for effectively moving toward the solution of the problem. The question to be answered is: "Who does what and when do we need to do each activity and organize ourselves to accomplish our goals?"

Collective action describes the process of effectively executing the action plan and the evaluation of its outcomes. The model identifies five key action steps:

1. Assignment of responsibilities – To convert a plan into action, specific people must take responsibility to accomplish specific tasks within a specified period of time. Someone must take responsibility for each of the activities identified in the action plan.

2. Mobilization of organizations – Obtain the support and help of pre-existing community resources. Communication through the local media can be an invaluable resource for mobilizing community support and activity. The media can facilitate the dialogue and action process as follows:

    a. It can support the diagnosis of problem situations and the presentation of the problem to the community.
    b. It can stimulate community deliberation and the prioritizing of problems.

c. It can support the exchange of ideas and experiences among distant communities.
d. It can help community organizations find solutions to problems and in the action phase, communication and local media can contribute by:
e. Informing the community about available services and how to gain access to them.
f. Training community members how to use the media to inform the general public about their needs.
g. Helping communities to obtain legitimization and support from authorities.
h. Providing feedback to the community about the progress and achievements of community projects, and
i. Praising/rewarding communities for their achievements and thereby enhancing member's self-esteem and sense of collective self-efficacy.

3. Implementation – Refers to actual execution of the action plan and its monitoring. No plan can be successful if the required work is not done. Leaders, members, and subgroups should take responsibility for monitoring all the tasks assigned making sure that activities are moving according to the timetable and everyone is fulfilling their responsibilities.

4. Outcomes – Refers to the actual results that the community is able to achieve given the resources, organization, and mobilization process specified in the action plan and then carried out.

5. Participatory Evaluation – Compare the outcomes to the shared vision and original objectives. The result of the participatory evaluation should be anew reassessment of the current status of the community with respect to the problem.

The state of the community in terms of the status of the individual who comprise it as well as the community as a whole can be measured at any time before, during and after a development project has been undertaken. The potential outcomes of dialogue and collective action for the individuals who participate include:

1. Improvement in skills necessary to perform new behaviors;
2. Ideational factors such as knowledge, beliefs, values, perceived risks, subjective norms and even self-image; emotional responses such as feelings of solidarity, empathy, and confidence; and increase in social support and influence from others as well as increased advocacy to others;
3. Intention to engage in new behavior in the future;

4. Specific behaviors related to the problem addressed by the dialogue and collective action. The model also indicates that these individual outcomes can be the result of the direct influence of one of the external catalysts identified in the model, such as mass-media messages that promote specific practices.

The model lists seven possible outcomes of social change that may occur:

1. Leadership – Development of sustained and effective leadership, which provides a base for organizing community participation, is an important outcome indicator for social change. Strong and supportive leadership is characterized by a combination of open management, shared vision, team spirit, decentralized control, and role clarity.

2. Degree and equity of participation – This dimension measures the range of participation to include the traditionally disenfranchised members of the larger community and the diversity of activities which members get involved, ranging from planning, selection of leaders, decision on services and modes of delivery, resource mobilization and management, to evaluation of program outcomes.

3. Information equity – This refers to the level of awareness about an issue that is shared (common wisdom) among different individuals within a group or between different groups in a community. Individuals with a good understanding about the issue or program and with access to sources of information will be more likely to participate, and that will reinforce other social change outcomes such as sense of ownership.

4. Collective self-efficacy – This refers to the group's shared belief in its conjoint capabilities to attain their goals and accomplish desired tasks.

5. Sense of ownership – This is defined as the community's feeling/belief that the problem/issue and/or program belong to them and they have a commitment to the program. Sense of ownership reinforces what people learn and encourages them to integrate the shared learning into related situations.

6. Social cohesion – Social cohesion consists of the forces that act on members of a group or community to remain in, and actively contribute to the group. In cohesive groups, members want to be part of the group; they generally like one another and get along well, and are loyal and united in the pursuit of group goals. Social cohesion is an important antecedent and consequence of successful collective action. Social cohesion mediates group formation, maintenance, and productivity.

7. Social norms – Social norms are the collectively agreed-upon standards and rules that are adhered to and accepted by the majority of the members of a particular society or group. Social norms are people's beliefs about the attitudes and behaviors that are normal, acceptable or even expected in a particular social context.

Technology Transfer Mechanisms

Different technology transfer mechanisms have been devised to ensure rural development. The following are some of the technology transfer mechanisms developed by PCARRD.

A. Technology Assessment (PCARRD 2001)

Technology assessment is a type of policy analysis that supports decision making about technology or technological projects. It is the process of anticipating and analyzing a broad range of socio-cultural, technical, economic, environmental, and political/legal aspects prior to the introduction of a given technology or even while a technology is being promoted or commercialized. It is designed to anticipate the gaps and risks associated with technology transfer and utilization. Appropriate interventions are determined to mitigate such gaps/risks.

Recent trends in technology management already include technology assessment in the design and development phase of new technology instead of doing evaluation after a specific technology has been generated. This approach is based on the idea that during the course of technology generation, choices are constantly being made about the form, the function, and the use of a technology and consequently technology generation can be directed to suit the requirements of various stakeholders concerned.

Technology Assessment Protocol

A technology assessment protocol (TAP) was developed by PCARRD to provide the step-by-step process of evaluating technologies for eventual promotion and commercialization.

Step 1 – Technology Identification/Pre-screening

a. Technology classification – Classify the technology whether it is a product, process, information or service.

b. Technology characterization – Gather, examine, and analyze all possible sources of information about a particular technology.

c. Technical feasibility – Screen and prioritize technologies which should be subjected to TAP. This screening aims to fast track the short listing of technologies for assessment, thus saving time, money, and effort in evaluating technologies which are not technically feasible in the first place. Evaluate the validity, reliability, and replicability of technologies.

Recommend for further R&D work technologies found having certain technical problems. On the other hand, proceed to the next step if the technology is found to be technically feasible.

Step 2 – Technology Scanning

This is a process to gauge the state-of-the-art of a particular technology. Scanning measures the socio-cultural, technical, economic, environmental and political (STEEP) aspects of a technology. The output of technology scanning is a recommendation for either: a) detailed assessment of technologies or b) return of technologies to R&D stage for refinements.

Step 3 – Technology Validation

a. Table evaluation – Use the following tools: Quick Resource Appraisal, a gap identification tool; and the Risk Management Process, an intervention identification tool.

b. Field evaluation – Validate the findings in the field.

Results of TAP will be recommended interventions for technology packaging, promotion, and/or commercialization or the repackaging of technologies already being commercialized.

B. Farmers' Information and Technology Service (FITS) Centers

This is an information and technology delivery service facility, which is aimed at improving access of farmers, traders, processors, entrepreneurs, and other stakeholders to information and technologies in agriculture and natural resources.

As provider of information service, FITS provides information materials in different formats such as print, audio-visual, and e-based media. A pool of experts may be tapped to render appropriate services and to package information and technology services to clients. FITS centers respond to client needs in terms of technology clinic, training, caravans, sale of planting materials, linkaging, and enterprise development.

C. Farmer-Scientist Bureau

This is composed of outstanding farmers who demonstrate successful application of S&T-based and indigenous technologies. These farmers are active participants, enablers,

facilitators, or initiators of technology development and transfer processes.

Participating outstanding farmers are identified, evaluated and selected based on a set of criteria. The farmer-scientist has the following functions:

- Acts as resource person during trainings, seminars, field days, investment clinics, cross-visits, etc.
- Provides technical assistance and hands-on training and shares experimental insights to on-farm visitors and other trainees.
- Devotes a certain portion of his/her farm as demonstration plot for his/her own on-farm trials.
- Tests/applies technological information learned from the seminars and cross-visits attended; and
- Influences other farmers in adopting his outstanding farm practices by sharing information, experiences, resources, and ideas.

D. Regional Applied Communication Office (RACO)

The RACO is an integral part of the Regional Research Consortium of the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD). It is an organization of communication specialists within the Research Consortium. The RACOs undertake Information Education and Communication (IEC) activities, a research- and need-based communication process aimed to hasten adoption of technologies by clients. IEC involves needs assessment, objective setting, communication planning, design and production of prototype, testing and dissemination of IEC materials in print, audio-visual, broadcast and other electronic formats, impact evaluation, and interpersonal approaches such as information caravan, and technology exhibits. Generally, the RACOs pursue six activities, which vary in scope depending on the need and resources available among members and cooperating agencies.

Publications/prototype production

This activity includes planning, preparation and production of publications such as annual reports, newsletters, leaflets, brochures and other printed materials on practicable technologies.

Instructional materials production

Realizing the limitation of publications, the RACOs have embarked on the production of low-cost instructional materials such as posters, slide tape presentations, primers, techno guides, and fact sheets on recommended technologies.

Scientific literature services

Through the RACOs, the scientific literature services in the regions have actuated in orchestration with PCARRD's national research information retrieval and documentation program.

Mass media linkages

Given considerable mileage the RACOs use the mass media for technology dissemination. Most RACOs use radio as a medium for technology dissemination.

Communication research

Having been involved in communication and evaluation research for years, some RACOs conduct communication research to further improve communication project planning and implementation, e.g. needs assessment, pre-testing/post-testing, impact evaluation, etc.

Communication training

To develop communication capability, the RACOs conduct trainings and workshops in communication.

E. Information and Communications Technology (ICT)

ICT facilitates information flow and enables the service providers to respond quickly to meet the needs of the clients. ICT includes information database and the internet, as strategy support. Databases piloted and installed in various FITS Centers include technology, manpower, infrastructure, publication, and other databases. The Internet may also be accessed by the clients for up-to-date information relevant to the agriculture and natural resources sectors.

Conclusion

Technology transfer leads to development in rural areas. Technology transfer is people-oriented. It affects specific individuals and society, in general. Whether linear or reciprocal, the framework of technology transfer includes exchange of symbols among individuals. Communication is central to implementing any technology transfer activity. For communication is "the lifeblood of society". It is the thread that binds society together. The information society that we're living in now proves the importance of communication to technology transfer.

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Agricultural Technology Transfer and Its Consequences
23-27

Taiwan Agriculture in the Era of Globalization[1]

Ming-Ming Wu[2]

Introduction

The term "era of globalization" is defined as the utilization of international resources and free competition among all nations. With the new round of World Trade Organization (WTO) negotiations, the "magnetic effect" of mainland China as well as the potential development of FTAs (free trade agreements) have increased the complexity for Taiwan in developing strategies to deal with such diversified issues.

Since international trade is beneficial for improving resource allocations, market-scale expansions, the division of labor, and consumer welfare, world trade liberalization will be a mega-trend of the future.

All countries, especially members of the WTO, including Taiwan, are going to have to liberalize their markets and reduce tariff rates and subsidies, according to the WTO clauses. These changes are inevitable, but we must be aware of these evolutions in the world's trade environment, and re-evaluate our strengths and weakness in order to create opportunities out of threats.

International Competitive Ability Continuing to Weaken

It is possible to examine Taiwan's international competitive ability by reviewing changes in the import and export amounts of agricultural production. In 1986, the amount of exportation was US$ 2.85 billion while in 2001; it was US$ 3.03 billion. The amount of importation in 1986 was US$ 3.72 billion, and in 2001 it was US$ 6.85 billion. While there was only a minor increase of exportation of US$ 0.18 billion in those 15 years, the amount imported dramatically increased by US$ 3.13 billion, so the trade deficit had dramatically worsened.

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Because free trade policies have been implemented in Taiwan, our agriculture is facing more risks than ever before. The incomes that farmers receive are declining, their assets are contracting, and the living standard of farmers has yet to be improved. The policies of "upgrading the industry and improving our agricultural competitive ability, ensuring food security and consumer sovereignty, increasing farmers' income and welfare, adequately utilizing agricultural resources, enhancing harmony with the environment and ecosystems, and developing a win-win situation by working together with mainland China and all international counterparts", are all far behind their designated schedules.

Over a long period of time, mainly due to both the ruling and opposition parties being concerned about affecting minority benefits and losing votes, risks from the introduction of free market policies have increased. Aging farmers, in an effort to maintain the status quo, refuse to reform. High adjustment costs prevent most farmers from changing businesses. A lack of awareness of the crisis due to potential threats from China, and ignorance of the effects of globalization have resulted in delays in the procedural augmentation of laws and policies; budget allocations are outdated and without proper efficiency evaluations. Other problems include the misallocation of water and land resources, the failure to adjust production and marketing structures, the loss of high-tech capital and talent, inefficient export expansion, the surging increase in imports, and the continually widening gap between urban and rural markets.

Globalization allows the free operation and movement of resources and products among nations. Thus, drastic reforms of the protectionist and subsidization policies of the formerly closed economy in Taiwan are required. Production and marketing structures of the industry should immediately be adjusted under the principle of comparative advantages. The principle of "Taiwan priority" and the best allocation of macro-resources should be demanded. Otherwise, Taiwan will lose its niche in the market as globalization strengthens.

Two Big Reforms, Five Crucial Policies

With the rapid progression of globalization, the actions of "drastic reform and a striving economy" are inevitable. The two big reforms for farmers and agribusiness organizations as well as agricultural administrative and R&D agencies should be prioritized. Five crucial policies for the reasonable allocation of land and water resource include the efficient promotion of delicate agriculture, solid improvements in the living environments of rural areas, appropriate promotion of cross-Strait investment and trade, and the rapid marketing of rural scenery and agricultural products.

For instance, agriculture water use accounted for 75% of total water usage in Taiwan in 2001; however because of a shortage of water supply in 2002 caused by a long drought, a large area of cultivation was forcibly taken out of production by the government. Obviously there is an urgent need for water resources to be rationally allocated when facing an uncertain climate.

Enhancement and re-construction of farmers and agri-business organizations

There is a variety of new organizations continuingly being set up in Taiwan, such as farmers associations, fishery associations, irrigation associations, agricultural cooperatives, cooperative farms, agricultural production and marketing teams, agricultural associations, agricultural improvement associations, foundations, agricultural trading and manufacturing associations, strategic alliances, etc. Mainly due to the inactivity of existing organizations, some of which are not even legal entities or natural persons, the provision of services to farmers has been unsatisfactory, and some of them were merely set up for election purposes.

There are reported to be 304 farmer associations, 40 fishery associations, 253 agricultural cooperatives, 200 cooperative farms, and 6717 production and marketing teams with overlapping functions. Members often lack of a professional background and are fairly weak in marketing knowledge as well as marketing abilities.

There is a resolution to elevate competitiveness by promulgating an *Agricultural Cooperative Law* or by promoting marketing boards, and constructing a fair system and competitive environment, which would apply to all parties.

The organizational framework of agricultural administrative and R&D agencies needs to be re-structured

Agricultural production value is decreasing, while production and marketing structures have dramatically changed together with macroeconomic growth. Nevertheless, food security, environmental protection, resource conservation, marketing, and trade have become more crucial these days. The existing administrative and R&D agencies are however mostly ineffective and are deficient in appropriate human resource allocation. It is necessary to consolidate the functions of these agencies, to establish statutory bodies for rapid-reaction services to production and marketing, to offer field management, product packaging, and product authentication, etc. According to the re-structuring program of the Executive Yuan, several bureaus and/or departments, some of which are under the Council of Agriculture, can be merged into other ministries. A thorough feasibility study would have to be reevaluated before such reform procedures are implemented.

Promoting Rural Scenery and Creating Quality Product Images

Taiwan has spectacular rural sceneries, hard-working farmers, outstanding agricultural technology, convenient transportation and communications, as well as a high agricultural budget (i.e., US$ 2.75 billion of the budget was allocated for agriculture in 2001). Taiwan has long been experienced and outstanding in marketing and trade. In the era of globalization, this is an extremely good opportunity to improve Taiwan's agricultural economic growth. Three crucial strategies are to develop leisure agriculture, to activate wholesale markets, and to elevate the image of domestic products.

Encouraging the development of leisure agriculture, creating job opportunities, and improving the rural economy

Leisure agriculture means to promote Taiwan's scenic resources and is one of the crucial measures in implementation of the policy of "doubling the number of overseas tourists and new hometown construction". However, the situation with laws and regulations has yet to be resolved, while in the meantime, many leisure farms, leisure forests, leisure fisheries, leisure livestock farms, tourist fruit orchards, vegetable plantations, gardens, tea farms, educational farms, civil farms, and farm hostels are forced to run their businesses illegally.

Activating wholesale markets

Wholesale markets need to be restructured and deregulated in order to provide an efficient trading and distribution environment. It is recommended that the operational entities be either public owned/privately run or entirely privately run. Food safety and open information should be highlighted, the distance for the distribution of livestock should be shortened, unfair taxation and land-leasing discrimination should be avoided, restrictions on traders should be limited, and disputes over cooperative marketing should be resolved. There should be cross-county cooperation to construct a multi-functional logistics center including agricultural wholesale markets, while moving old wholesale markets out of downtown areas, in order to avoid pollution, reduce distribution costs, assure food safety, improve urban living quality standards, etc.

Elevating the image of domestic products

All domestic products targeted for domestic and international high-value markets should be examined for both safety and quality. However, selling prices of those farms which have obtained certification from GAP, CAS, and GMP have not increased; obviously, we still need to enhance field management, further promote examination for residuals of agrichemicals and prohibited chemicals, and educate consumers. The authority should also encourage consumers to purchase domestic products, and to implement indirect subsidies by

encouraging forwarders and hypermarket owners to collect lower freight and display fees. In addition, allowing non-agricultural enterprises to share the same preferential treatment as agricultural and agribusiness organizations in order to construct a competitive environment should be considered.

This article only discusses marketing issues of rural scenery and domestic agricultural products; other experts will further elaborate on the topics of water and land resources, delicate agriculture, rural development, and cross-Strait agricultural trade and investment.

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29-58

Case Studies on Transferring Technologies of Agribusiness-scale Production and Marketing of Asparagus and Mushrooms to Indonesia[1]

Sung-Ching Hsieh[2]

ABSTRACT

Agriculture is the main stay and the largest sector of Indonesia's economy. Efforts have been made by the government of Indonesia to enhance food production to feed ever-increasing population in the country. Taiwan has enjoyed a high agricultural productivity through developed modern agricultural technologies in recent years. The transfer of Taiwan experienced agricultural technologies to the needy nations, becomes an important program of international technical cooperation of the ROC on Taiwan in the past 40 years.

At the request of the Indonesian government, Taiwan dispatched the Agricultural Technical Missions to Surabaya and Yogykata Provinces to help boost agricultural production in May 1976. Taiwan-assisted production of food crops and vegetables (rice, soybeans, and corn) boosted the Indonesian economy. In July 1995, Dr. Paul Min-hsien Sun, Chairman of the ROC Council of Agriculture, signed a Memorandum of Understanding (MOU) with Dr. Sjahrifudin Baharsjah, Indonesian Minister of Agriculture for a new phase of agricultural cooperation between the ROC on Taiwan and Indonesia. Taiwan agreed to transfer agribusiness-related knowledge and technology to the farmers in rural communities, and promote joint investment in the production, processing, and marketing of agricultural commodities.

Based on the MOU, the ROC Agricultural Technical Mission carried out cooperative projects on asparagus and mushroom production in Central Java Province. Mr. Kung-Chu Wu, an asparagus expert from Taiwan, organized the farmers in Boloyali County into six asparagus production and marketing teams. The farmers earned US$ 4,982/year from one

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hectare of land on which asparagus had been harvested. A marketing supervision unit has been established to help in selling asparagus since that time.

With the help of Professor Jack J. C. Hsieh of National Chung-Hsing University, the Indo Evergreen Company was established in the form of a joint venture project by a private joint Taiwanese/Indonesian investment. Mushroom-growing technology has been transferred to Indonesia from Taiwan and Belgium. Today Indo Evergreen Company produces 30 metric tones of processed mushroom everyday, of which, 95% is exported to North America and Japan, and 5 % is sold in Indonesia domestic market.

Mr. Yeh-hsuen Yu, a mushroom expert from National Taiwan University, transferred the business-scale production technology for wood ear mushroom. The project was carried out in Sleman County, Yogykata Province, and Indonesia. Mr. Yu established four ear mushroom production processes: (1) production of seed fungus growing bottles, (2) production of ear mushroom fungus inoculated plastic bags, (3) Supply of plastic bags to the growers, and (4) marketing of dried ear mushrooms through Farmer's Cooperatives. The farmers earned a net profit of US$ 186,606 from annual harvest of the wood-ear mushrooms. Plastic bag processing station earned a total of US$ 48,000/year, while seed fungus propagation station earned US$ 7,333/year. The amount of income from Marketing through Farmer's Cooperatives totaled US$ 112,000/year. The total output of the project amounted US$ 354,000/year. These are successful stories of technology transfer through international technical cooperation, jointly executed by various parties in Taiwan and Indonesia.

Introduction

Forty years have elapsed since the Republic of China on Taiwan launched the Operation Vanguard and dispatched technical missions to friendly nations in many parts of the world. The earlier efforts focused on food crops, vegetables and livestock. The first Agricultural Technical Mission (ROC-ATM) was established in the early 1960s in Africa. Starting from November 1972, all official technical assistance programs were transferred to the Committee of International Technical Cooperation (CITC), a semi-autonomous agency financed by the ROC government. The CITC was reorganized into the International Technical Cooperation and Development Fund (ICDF) in July 1996. The ICDF continues the work of international cooperation projects initiated by the CITC.

During the years since Operation Vanguard, the ICDF and its predecessors have devoted more than eleven thousand man-year of specialized assistance in overseas service missions, in six geographical regions. Mutually gratifying accomplishments have resulted from the collaborative ventures. After receiving a request for technical assistance from a

country, the ROC first send a survey team of experts to visit the country, to study possible areas for cooperation. The study mission works with officials of the host country to draft outlines of cooperating projects. An agreement or MOU for technical cooperation is then written and signed by the representative officials of the host country and the ROC on Taiwan.

In May 1976, represented by the Chamber of Commerce, Indonesia and the ROC signed an agreement on agricultural technical cooperation, which has been renewed in every two years. The first mission was sent to Surabaya in East Java in November 1976. In 1979, the second mission was sent to Yogyakata Province to help agricultural production. In July1995, Dr. Paul Ming-hsien Sun, Chairman of the ROC Council of Agriculture led a delegation of 15 experts including the writer (Hsieh 1955). The party conferred with the Indonesian Minister of Agriculture Dr. Sjahrfudin Bahasjah about the new phase of agricultural technical cooperation. The ROC on Taiwan agreed to help carrying out four rural development projects in Eastern and Central Java. Dr. Bahasjah and Dr. Sun signed the MOU in Jakarta on July 16, 1995. Based on the MOU, the ROC Agricultural Technical Mission (ROC-ATM) launched new projects of mushroom and asparagus production.

After four years of intensive work, mushroom and asparagus become an important food crop in Western Java. With the assistance of the ROC-ATM, the farmers are organized into the "Production and Marketing Teams" based on the Taiwanese model, to facilitate production and marketing of the agricultural products. Concurrently, private investors established an agribusiness scale production and processing plant. Mushroom culture and processing technologies have been transferred from Taiwan, with the assistance of professor Jack J. C. Hsieh of National Chung-Hsing University. This paper deals with the result of the technology transfer from Taiwan to Indonesia.

1. General description and agricultural situation of Indonesia

Indonesia is the world's largest archipelago, composed of more than 13,000 islands, 600 of which are inhabited. It lies along the equator for a distance of 3,200 miles. This country ranks fifth in world population, with more than 198 million people in 1995, and a population growth of 2.1% per year. About two thirds of the population lives on the islands of Java and Bali, which constitute seven percent of the nation's area. Java is one of the most densely populated areas in the world, with nearly 2,000 people per square mile. Indonesia is a centralized republic, divided into 27 provinces. Each province is divided into districts and each district comprised of sub-districts. A village is the lowest administrative unit in a sub-district.

Agriculture is the mainstay of Indonesia's economy, representing about 35 percent of the total GDP and employing approximately 63 percent of the work force. The sector has a dualistic structure. Approximately 142 million hectares are cultivated in small operations by 24 million small farmers and 22 million hectares are cultivated in large operations through 2,000

estates. Small farmers whose farm size ranging from 0.1 to 3 hectares dominate production of all subsistence and cash crops, except oil palm and tea. The most important food crops grown by small farmers are rice, corn, cassava, sweet potatoes, peanuts, and soybeans. A variety of export crops such as rubber, coffee, coconut, and fiber also produced. Livestock is usually raised with food crops and secondary crops. Poultry, beef cattle, and dairy cattle are the most commonly cultivated livestock. Fisheries are also an important agricultural commodity, with the industry dominated by small fisherman. The most important fish catches by small fishermen are shrimp, prawn, tuna and skipjack.

2. Transfer of technology for production and marketing of asparagus and other vegetables from Taiwan to Boyololi County in Central Java

(1) General situation in Boloyali County

Boyolali County is located in the southern part of Central Java Province. The county spans 40 km from east to west and 50 km from south to north, with a total land area of 10,151,010 hectares. The tropical climate consists a dry season (May~September) and a wet season (October~April) with temperatures ranging 18~32 °C. Total population of the county is 895,527 persons (1969) with a population density of 883 persons per square kilometer. The main crops include rice, tobacco, corn, soybean, peanut, cassava, sugarcane, cabbages, carrots, cucumbers, peppers, eggplants, melons and various leafy vegetables.

(2) Signing of Memorandum of Understanding (MOU) for Agricultural Technical Cooperation between Indonesia and R.O.C. on Taiwan

Dr. Paul Ming-Hsien Sun, Chairman of the ROC Council of Agriculture, and Indonesian Minister of Agriculture Sjahrifudin Baharsjah, signed MOU for agricultural cooperation in Jakarta on July 16, 1995. Based on the MOU, Taiwan agreed to help Indonesia to establish agribusiness pilot projects (Figure 1) with financing and to send experts to implement the projects which includes the following activities:

1) Transferring agribusiness related knowledge and technology to the farmers in rural community.
2) Conducting research and training and study tours to implement pilot projects.
3) Promoting joint investment in the production, processing, and marketing of agricultural commodities.
4) Developing an agribusiness support system in the rural area.

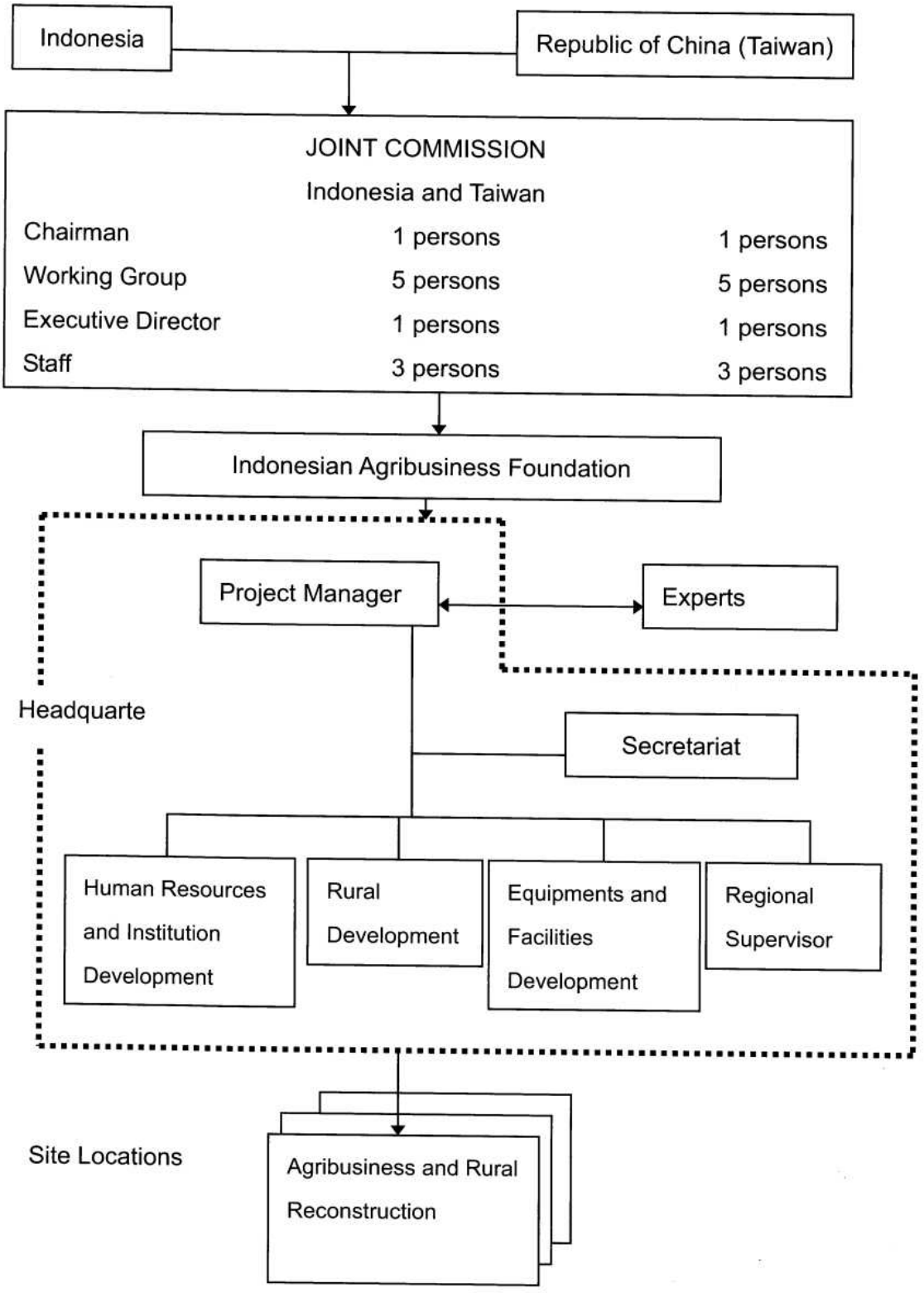


Figure 1. Frame work and structure of joint cooperation between Indonesia and ROC on Taiwan

(3) Execution of the vegetable production and marketing project

1) Establishment of demonstration farms

After signing the MOU for agricultural technical cooperation, in capacity of Executive Secretary, Committee of International Cooperation, the writer (Hsieh1995) made an on-the-spot survey to Boloyali, and worked out a detailed plan for the vegetable production project with the Boloyali officials and ROC-ATM experts. Dr. Cherng Liang Tsai, Leader of ROC-ATM, assigned Mr. Kung-Chu Wu to execute the project. Ir. Sipi Djoehadiah, Director of the Boloyali County Bureau of Agriculture, was assigned to be Dr. Tsai's counterpart. Boloyali County provided two sites (Teras and Gepogo Townships) for setting up demonstration farms. The farms are used as the bases of planting newly introduced vegetables, training and extension work. Farmers in Boloyali are hard working, and eager to learn new things. This farmer's positive attitude made the extension work easier. Initially, 3.1 hectares of land was used for the demonstration and training of vegetable culture (Table 1).

Table 1. Sites of vegetable demonstration plots

Location	Acreage (ha)	Kind of vegetables
Teras Extension Station	0.7	Asparagus, peppers cucumbers, string beans etc.
Gepogo Extension Station	0.6	Sweet peppers cherry tomatoes, peas and lettuce etc.
Simo Women's Production Team	0.2	String beans, cucumber, tomatoes, egg plants, etc.
Algemlak women's Production Team	0.2	String bean, beans cucumber, tomatoes, eggplant etc.
Andong Women's Production Team	0.2	String beans, cucumber, tomatoes etc.
Gumuksejio Women's Production Team	0.2	Asparagus, pepper, egg plant, string beans, tomatoes, cucumber
Ngemplak Women's Production Team	0.2	Cucumber, string beans, lettuce etc.
Mojosogo Women's Production Team	0.2	Asparagus, string beans, pepper, cucumber
Dlingo Farmer's Production Team	0.2	Asparagus, string beans
Singosari Farmers Production Team	0.2	String beans, Okura, cucumbers, pepper, egg plant etc.
408 Army Unit of Boyolali City	0.2	String bean, phaseolus bean, Okura, pepper and eggplants etc.
Total acreage	3.1	

Source: K. C. Wu and C. L. Tsai (1997)

2) Organization of Vegetable Production and Marketing Teams

With the initial success of the field demonstrations, Mr. Wu expanded the project to include other sites for vegetable production in Boloyali following years (1996-1997). Mr. Wu organized the farmers into Production and Marketing Teams (PMT) for the integrated farming, to reduce the production cost. At this stage, a total of 116 farmer's households were organized into six PMTs to run the 19-hectare farm (Table 2).

Table 2. Farmers' households organized into Production and Marketing Teams in Boloyali, 1996-1997

Name of Production and Marketing Teams (P.M.T.)	No. of farmers' households	Size of farm (ha)
Bangsalan PMT	29	4.39
Jembungan PMT	21	4.59
Karangdure PMT	4	2.60
Dlingo PMT	20	2.10
Jurug PMT	8	2.00
Miwis PMT	20	2.20
Mudal PMT	14	1.20
Total	116	19.08

Note: Locations:

Bangsalan Village, Teras Township
Jembungan Village, Banyadsno Township
Karangduren Village, Sawit Township
Dlingo Village Mojosongo Township
Jurug Village, Mojosongo Township
Mliwis Village, Cepogo Township.

3) Improvement of cultural system in Boloyoli

In past years, Boloyali's farmers practiced traditional rice-based agriculture, and earning very low incomes. In order to diversify the use of land, Mr. Wu conducted a series of experiments on rice-based rotational culture with other vegetables. Six rotational systems had been recommended to farmers for adoption. The farmers who adopted the new cultural system increased their income two times that of traditional system (Table 3). The newly established rotational farming systems are now widely used in Boloyali, especially by the vegetable PMTs.

Table 3. Comparison of farming income between the traditional and recommended rotational systems of farming in Boloyali County

	Rotational system			Net profit (US$/ha)	Difference (A-B)
	Jan.-Apr.	May-Aug.	Sept.-Dec.		
(A):	Rice	Musk melon	Bitter gourd	3,521.3	3,056.8
(B):	Rice	Rice	Rice	464.5	
(A):	Pepper	String beans	Musk melon	4,851.4	4,385.8
(B):	Rice	Tobacco	Rice	465.6	
(A):	Tomato	Rice	Musk melon	3,448.1	1,691.7
(B):	Rice	Tomato	Rice	1,756.4	
(A):	Cucumber	Rice	Musk melon	2,848.8	202.1
(B):	Rice	Pepper	Rice	2,646.7	
(A):	Rice	Musk melon	Pepper	4,338.5	2,182.2
(B):	Rice	Musk melon	Rice	2,156.3	
(A):	Mask	Bitter gourd	Pepper	5,703.5	3,873.9
(B):	Rice	Bitter gourd	Rice	1,829.6	

Note: (1) The exchange rates US$ 1: Rp 7,500. (2) Source: K. C. Wu and C. L. Tsai (1997).
(A): Recommended Rotational system; (B): Traditional cultural system.

4) Asparagus production and marketing project

Asparagus is a high valued cash crop in Indonesia. In order to develop the asparagus industry, some investors introduced asparagus in the Medan District of Northern Sumatra Province for plantation in 1990. In spite of enormous efforts made by the investors, for technical reasons the asparagus production was not very successful. They eventually abandoned the idea of growing asparagus in Indonesia for many years.

Taiwan is well known for growing asparagus and was once the number one asparagus exporting country in the world (1960). The prosperous asparagus production in Taiwan depended mainly on the research development at Yi-Chu Asparagus Research Center. Because of this, the Boloyali County government requested that Taiwan transfer its asparagus production experience to Indonesia. In December 1995, in response to the request, the ROC-ATM introduced Tainan Sel. No. 3 from Yi-Chu Asparagus Research Center. Mr. Kung-Chu Wu, an asparagus expert from ROC-ATM was assigned to take charge of the asparagus project in Boloyali.

Mr. Wu planted the introduced asparagus on a small plot (0.25 ha) of the Teras Demonstration Farm for trial. The initial trial was quite successful, primarily due to the adaptability of asparagus variety Tainan Sen No. 3 to the Boloyali environment. The high ridge culture with the properly timed fertilizer application, and water management, enabled the young seedlings to grow quickly. After five months of growth, asparagus is at the stage of first harvest, the upper stem of the plant is cut off, but the root remained in the soil for development of new shoots. Organic fertilizer is applied at every cutting of the stem. This ratooned method of asparagus culture, widely used in Taiwan, was found to be very useful in Indonesia as well. The price of asparagus in the supermarket was around US$ 7 to US$ 8 per kg at trial sales.

Encouraged by the promising results, Mr. Wu then organized the farmers into different PMTs, to facilitate the transfer of technology (Table 4). With free seeds, instruction and training provided by Mr. Wu, the PMT members started planting asparagus (Table 4). Asparagus acreage increased rapidly reached 38.78 ha in 1988 (Table 5).

At the initial stage, the farmers did not know how and where to sell the asparagus. Mr. Wu and local extension officers then helped farmers to sell asparagus to Jakarta via air flight as a trial. The initial market response in Jakarta was very good, which gave the farmers in Boloyali County, the confidence that even more profit could be gained from the asparagus production. Mr. Wu then strengthened his efforts to train farmers to grow the high quality asparagus (Table 4). He also provided farmers with free seeds and fertilizer. The net profit of asparagus production from 1 ha of land was US$ 3,332.8 in the first years, and US$ 4,306.4 in the second year and increased to US$ 4,982.0 in the third years and thereafter (Table 6).

Table 4. Training program organized by ROC-ATM in Boloyali County (From July 1996 to November 1997)

Time/location	Subject	Category of participants	No. of participants
1996			
Oct./Teras	Agribusiness management	County extension agents	40
Oct./Dlingo	Vegetable culture	Termus (P.M.T.)	25
Nov./Singosari	Vegetable culture	Do	40
Nov./Dlingo	Vegetable disease control	Do	25
Nov./Singosari	Do	Do	40
Nov./Teras	Agribusiness management	County extension agents	20
Dec./Teras	Asparagus nursery technique	Women's team	25
Dec./Teras	Vegetable cooking	Village women	40
Jan./Bangalan	Asparagus nursery technique	Farmer (P.M.T.)	25
Jan./Bangalan	Vegetable culture technique	Farmers (P.M.T.)	40
Jan./Boyolali	Do	408 compound	
Feb./Teras	Field practice for vegetable culture	Farmers	40
March/Mudal	Vegetable culture technique	Farmers (P.M.T.)	20
March/Teras	Post harvesting technique of asparagus	Farmers (P.M.T.)	30
March/Mliwi	Vegetable culture	Farmers (P.M.T.)	40
April/Teras	Vegetable culture	Farmers (P.M.T.)	150
April/Dligo	Vegetable culture	Farmers (P.M.T.)	150
June/Teras	Agribusiness management	Extension workers	40
1997			
July/Teras	Vegetable production practice	Agri.Voc. School students	16
July/Metuk	Asparagus culture and post harvesting treatment	Farmers (P.M.T.)	25
July/Teras	Vegetable production lecture and field practice	College students and extension worker	57
July/Teras	Agribusiness management	Agric Ext. workers	6
July/Teras	Asparagus culture and post harvesting treatment	Farmers (P.M.T.)	25
July/Teras	Vegetable production	College students	7
July/Teras	Agribusiness management	Core farmers	24
Aug./Teras	Vegetable production technique	Agric. ext. worker	42
Aug./Sawit	Asparagus culture and post harvesting treatment	Farmers (P.M.T.)	30
Aug./Teras	Agribusiness management	County extension worker	21
Aug./Manggis	Asparagus culture and post harvesting treatment	Farmer (P.M.T.)	25
Sept./Mliwis	Do	Do	20
Sept./Manggis	Do	Do	20
Sept./Teras	Agribusiness management	County extension agents	
Oct./Teras	Do	Do	40
Oct./Teras	Do	Core farmers	6
Nov./Teras	Do	Core farmers	24
Total	35 Training courses		1258

Source: K. C. Wu and C. L. Tsai (1997)

Table 5. Acreage of asparagus production as a result of extension work by Mr. Wu Kung-chu of ROC-ATM in Boloyali County, 1995-1998 (Variety: Tainan Sel. No. 3 from Taiwan)

Location (village/township)	No. of farmers household	Planted acreage (ha)	Harvested acreage (ha)
Teras/Teras	11	2.24	2.24
Bangsalan/Teras	51	6.85	2.71
Salakan/Teras	23	1.715	1.325
Mudal/Boyolali	42	6.38	6.06
Tlatar/Boyolali	7	0.95	0.95
Jembangan/Banyudono	9	1.97	0.77
Mliwis/Cepogo	2	0.50	0.50
Dlingo/Mojosongo	15	0.955	0.25
Metuk/Mojosongo	33	3.67	2.23
Jurug/Mojosongo	30	4.14	1.82
Mangis/Mojosongo	11	1.73	0.97
Tlawong/Sawit	46	3.445	2.425
Gombang/Sawit	17	2.265	1.745
Cepogo/Sawit	7	0.80	0.41
Jenengan/Sawit	5	0.32	0.32
Ngampon/Ampel	8	0.555	0
Karangangko/Kleten	1	0.30	0
Total	318	38.785	24.729

Source: K. C. Wu and C. L. Tsai (1997)

Table 6. Estimated input and output of asparagus production in Boloyali, Indonesia (Based on 1 ha of land)

Input and output	Amount (US$/ha)		
	1 st year	2 nd year	Third year
(A) Input			
Land rent	333.3	333.3	333.3
Land preparation	93.3	0	0
Labor	800.0	800.0	800.0
Seed	32.0	0	0
Fertilizer	466.7	466.7	466.7
Agric. chemicals	20.0	20.0	20.0
Other materials	18.9	9.6	182.0
Total	1,764.2	1,629.6	1,802.0
(B) Output			
Annual yield (kg)	9,600 kg	11,200 kg	12,800 kg
Selling price/kg	0.53	0.53	0.53
Total output value	5,088.0	5,936.0	6,784.0
(C) Net profit: (B)-(A)	3,332.8	4,306.4	4,982.0

(1) Exchange rate US$ 1: Rp 7,500. (2) Source: K. C. Wu and C. L. Tsai (1997).

5) Marketing of asparagus

Marketing of asparagus and other vegetables is jointly supervised by the Agricultural Bureau of the Boloyali County Government and by ROC-ATM experts. The commodities produced by the PMT are collected at village commodity collection stations. The collected commodity is cleaned, washed, and weighed. The total collected commodities from different collection stations are then transported to the county commodity collection center. The commodities are then placed into different grades according to their quality. They are then packed, and sent directly to the local supermarkets. A portion of the collection is stored in a cold storage room for export to other countries. A flow chart of the asparagus distribution system is given in Figure 2.

The amount of asparagus sold at the initial stages in April 1997 was 191 kg. This increased to 3,862 kg by the end of 1997. The amount of asparagus sold in October 1998 increased to 9,033 kg, with net profit of US$ 7,016.2, compared to US$ 102, in April 1997. Since asparagus can be harvested year round, the accumulated product from April 1997 to December 1998 was 61,677.3 kg with a net market price of US$ 40,3221. This is certainly a good profit for the farmers in Boloyali (Table 7).

If asparagus and other vegetables produced by the PMT were pooled together, the amount sold would be ever higher. For instance, the amount of vegetables sold at the six-month period from July to December 1998 totaled 53,204.2 kg, with a net profit of 280,454,575 rupiahs or US$ 37,394 (Table 8). Farmers are very happy with this remarkable result. This is an example of a successful transfer of technology from a foreign country to Indonesia.

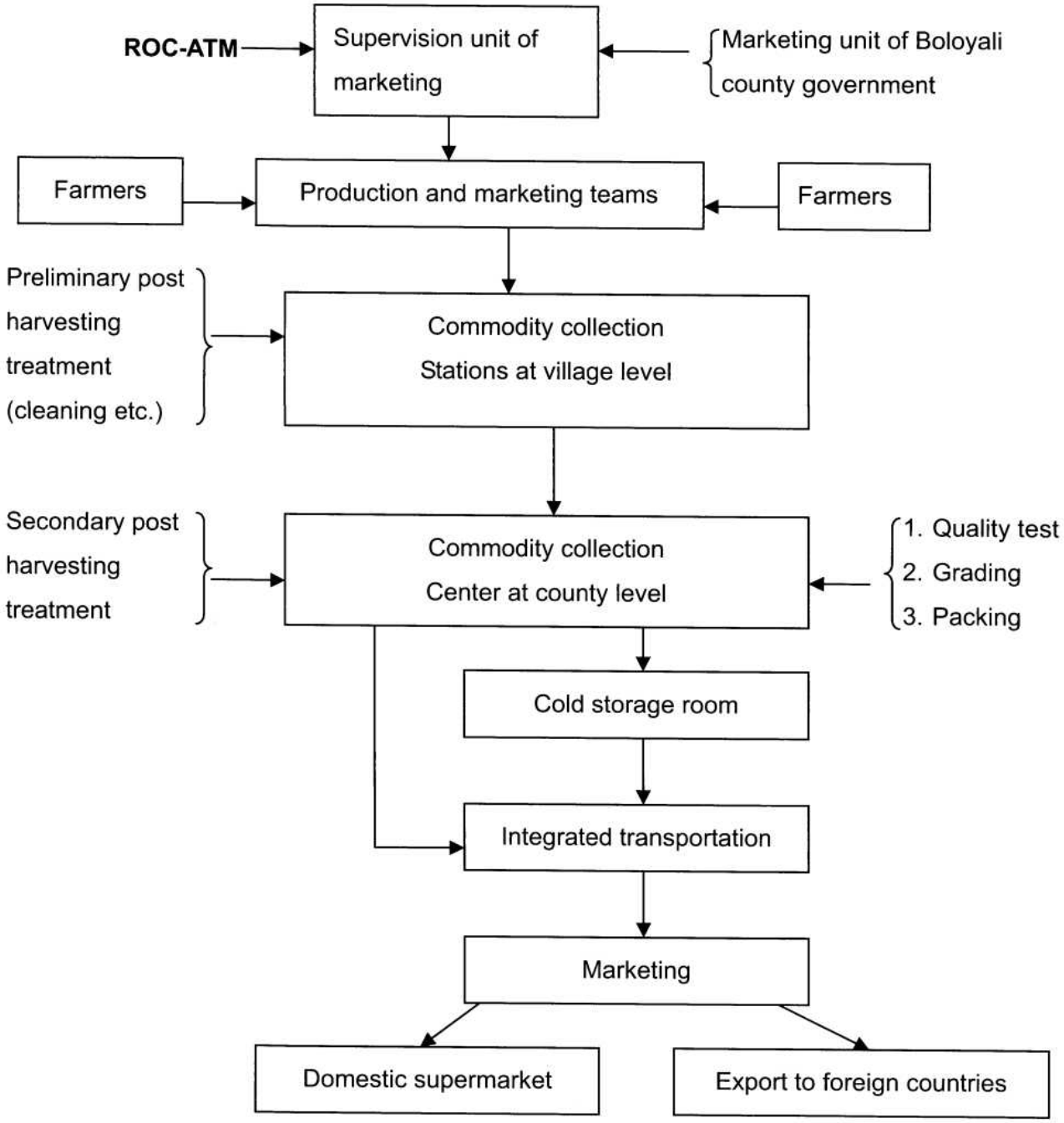


Figure 2. Flow chart of ROC-ATM cooperative asparagus and vegetable marketing in Boloyali, Indonesia.

Table 7. Marketing of asparagus in Boyolali County, April 1997-December 1998

Marketing period	Asparagus sold (kg)	Marketing Profits (US$)
04/1997	191.0	102.0
05/1997	169.0	90.1
06/1997	175.0	93.3
07/1997	512.0	273.1
08/1997	768.0	409.6
09/1997	1,008.0	537.6
10/1997	1,333.0	710.9
11/1997	2,375.0	1,266.7
12/1997	3,862.0	2,059.7
01/1998	3,727.0	1,987.7
02/1998	2,686.0	1,432.5
03/1998	2,375.0	1,266.6
04/1998	1,623.0	865.6
05/1998	2,205.0	1,149.3
06/1998	5,351.0	3,210.6
071998	4,413.5	2,208.0
08/1998	5,050.7	4,138.4
09/1998	5,681.1	4,183.8
10/1998	9,033.0	7,016.2
11/1998	5,609.3	4,488.9
12/1998	3,529.7	2,831.4
Total	61,677.3	40,322.1

Exchange rate 1US$: rupiah 7,500 Source: K. C. Wu and C. L. Tsai (1997)

Table 8. Asparagus and other vegetables sold through the marketing center at Boyolali County, July-December 1998

Marketing period	Asparagus and vegetables sold (kg)	Marketing Profit (US$)
07/1998	6,533.5	4,789.4
08/1998	7,817.3	6,323.8
09/1998	8,395.3	5,914.2
10/1998	14,786.7	9,937.9
11/1998	9,926.3	6,497.2
12/1998	5,745.1	3,930.1
Total	53,204.2	37,392.6

3. Transfer of technology for production and marketing of common white mushrooms from Taiwan to Bandung province of Indonesia

Indonesia has an environment suitable for growing many kinds of mushrooms. There are plenty of waste materials such as rice straw, baggase, sawdust etc. that can be used as the culture media for mushroom production. Additionally, production and labor costs are very low, and there is a great market for edible mushrooms in Indonesia.

(1). Development of technology for agribusiness scale production and marketing of common white mushroom (*Agaricus bispours*) in Indonesia

The Indo Evergreens Company, jointly invested in by the Taiwanese investor Yang Yung-chung and the Chinese Indonesian investor Choo Koh Guan, is producing common white mushroom with an agribusiness scale. In addition to growing mushrooms in large scale, the company runs a mushroom canning factory, with a total of 800 workers. The writer (Hsieh 1995) visited the company in Bandung in 1995 and was impressed by the scale and successful operation of the company. In this section, the observations made by the writer with regard to the operation of the company will be described.

(2). Mass production of common white mushrooms

Indo Evergreen is a joint venture cooperation between a Taiwan based company and Indonesian partners. Therefore, technologies are mainly transferred from Taiwan. With the transfer of technology and technical assistance from Taiwan, the company worked on a pilot project together with a team of consultants led by Prof. Jack J. C. Hsieh of National Chung-Hsing University in Taiwan in 1988. The objective was to determine the possibility of Champignon mushrooms being grown in the West Java on a year-round basis.

With the success of the pilot project, Indo Evergreen decided to launch a commercial scale mushrooms-growing operation, starting at the village of Sukamanah, with 8.5 hectors of land. They also constructed 300 units of mushroom growing house units. The company started the mushroom growing operation with a daily production capacity of six metric tons of fresh mushrooms.

While commercial mushrooms growing was still in development, the canning factory was constructed in the Banjaran area with 4.2 hectors of land. It is located 33 km from the plantation, a travelling distance of about 45 minutes to 1 hour by car. In late 1992, Indo Evergreen explored the possibility of expanding its mushroom growing operation with a target production of 12 metric tons of fresh mushrooms per day. With the support of the local government, the company agreed on a 20-year contract agreement with P. D. Manin to set up the second plantation site at Margakerta village. The second plantation site is about 10

minutes from the Sukamanah site plantation, occupying 35 hectors of land housed with an additional 300 units of mushroom growing house units and compost production facilities.

Both plantation sites are located in the Pangalengan area. The company has chosen Pangalengan for the mushroom growing operation because it has an altitude of 1,500 meters, with an average day time temperature of 22 to 26 °C, and an average night time temperature of 12 to 14 °C. Additionally, Pangalengan is a densely populated area.

The mushroom growing industry is both a labor- and capital-intensive industry. Because canned mushrooms are a commodity item, they are subject to the principle of supply and demand, which greatly affect the world marketplace. Because of expense of costly rice straws used in mushroom growing, Indo Evergreen decided to look for a substitute material. The substitute material found was sugar cane pulp, commonly known as "baggase". Bearing in mind that Indonesia is the only country in the world that uses "baggase" as compost for mushroom growing, and that the "baggase" has a different characteristic than that of rice straw, the company called in an experienced Belgium-based consultant firm to assist the company in further development.

Based on the technology transferred from Taiwan, two changes were made after the recommendation made by Prof. Jack J. C. Hsieh. The first was the separation of compost production facilities from the mushroom growing operations; the second was the use of 'baggase" as one of the basic compost production materials. These two changes were implemented in mid-1994. After the first six months of operation, the revised growing system began delivering convincing results. The company was then producing an average of 15 tons of fresh mushrooms per day. This method continued to show positive production results.

Indonesia is still the only country in the world that has a natural climatic condition for industrial scale year-round mushroom growing, which is an advantage over other mushroom producing countries. Indo Evergreen expansion plans to increase the fresh mushroom production capacity to 30 metric tons per day. The developmental process of Indo evergreen company is summarized in Figure 3.

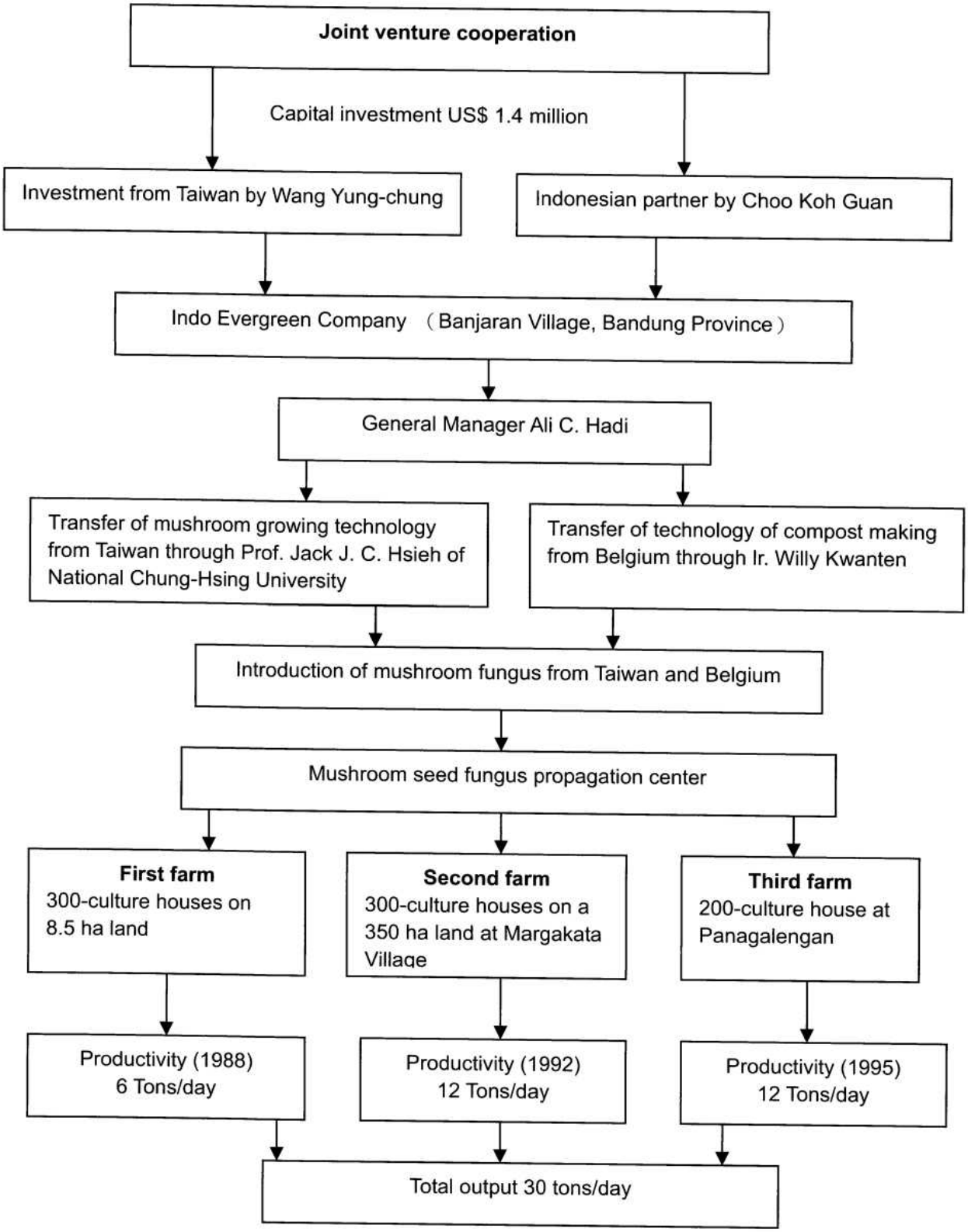

Joint venture cooperation
Capital investment US$ 1.4 million
Investment from Taiwan by Wang Yung-chung
Indonesian partner by Choo Koh Guan
Indo Evergreen Company （Banjaran Village, Bandung Province）
General Manager Ali C. Hadi
Transfer of mushroom growing technology from Taiwan through Prof. Jack J. C. Hsieh of National Chung-Hsing University
Transfer of technology of compost making from Belgium through Ir. Willy Kwanten
Introduction of mushroom fungus from Taiwan and Belgium
Mushroom seed fungus propagation center
First farm
300-culture houses on 8.5 ha land
Second farm
300-culture houses on a 350 ha land at Margakata Village
Third farm
200-culture house at Panagalengan
Productivity (1988) 6 Tons/day
Productivity (1992) 12 Tons/day
Productivity (1995) 12 Tons/day
Total output 30 tons/day

Figure 3. Development of mushroom production on an agribusiness scale in Indonesia

(3). Operation of the Indo Evergreen factory

The Indo Evergreen factory is equipped with facilities to pack both glass-jarred and canned mushrooms at approximately 30 tons per day. It is presently working on a 2-shift basis. Planned, designed, implemented and organized by the consultant team led by Prof. Jack J. C. Hsieh from Taiwan, the factory commenced its operation in September 1992, and just weeks later in November 1992, Indo Evergreen exported the first container loads to the United States.

The Indo Evergreen cannery operation is still growing, with the consistent support, sound guidance, advice, and guidance given by the processed food professionals from Taiwan, United States and Japan. The continuous support of the local government helps in maintaining and improving the infrastructure. Indo Evergreen has entered the competitive world marketplace and maintains its position as one, a producer's quality processed mushroom.

Today, Indo Evergreen exports 95 percent of its total production quantity, of which 50 percent goes to the United States, 40 percent to Japan and 5 percent to Canada, branded with popular brand names such as Green Giant, Kroger, Foodclub, Freshlike (U.S.), Blue Flag, Salad Club, Coop, and Inageya (Japan). The remaining 5 percent are distributed fresh and canned to local markets. Currently, the world's major mushroom consuming country is the U.S., with a reported total 68,500 tons of imported processed mushrooms in 1994. About 45 percent of the imports come from Mainland China, 20 % from Indonesia, 7 percent from Chile, 3 percent from Mexico, and the remaining 25 % from various countries throughout the world.

It is believed that agribusiness prospects in Indonesia will continue to show positive, and with continued supports, Indo Evergreen has the potential to gain market share in the future. With a favorable climate, the transfer of technology and technical support, there are still many agricultural and horticultural products the company believes can be grown and packed in Indonesia, with high export potential. The operation of Indo Evergreen mushroom processing and marketing is summarized in Fig. 4.

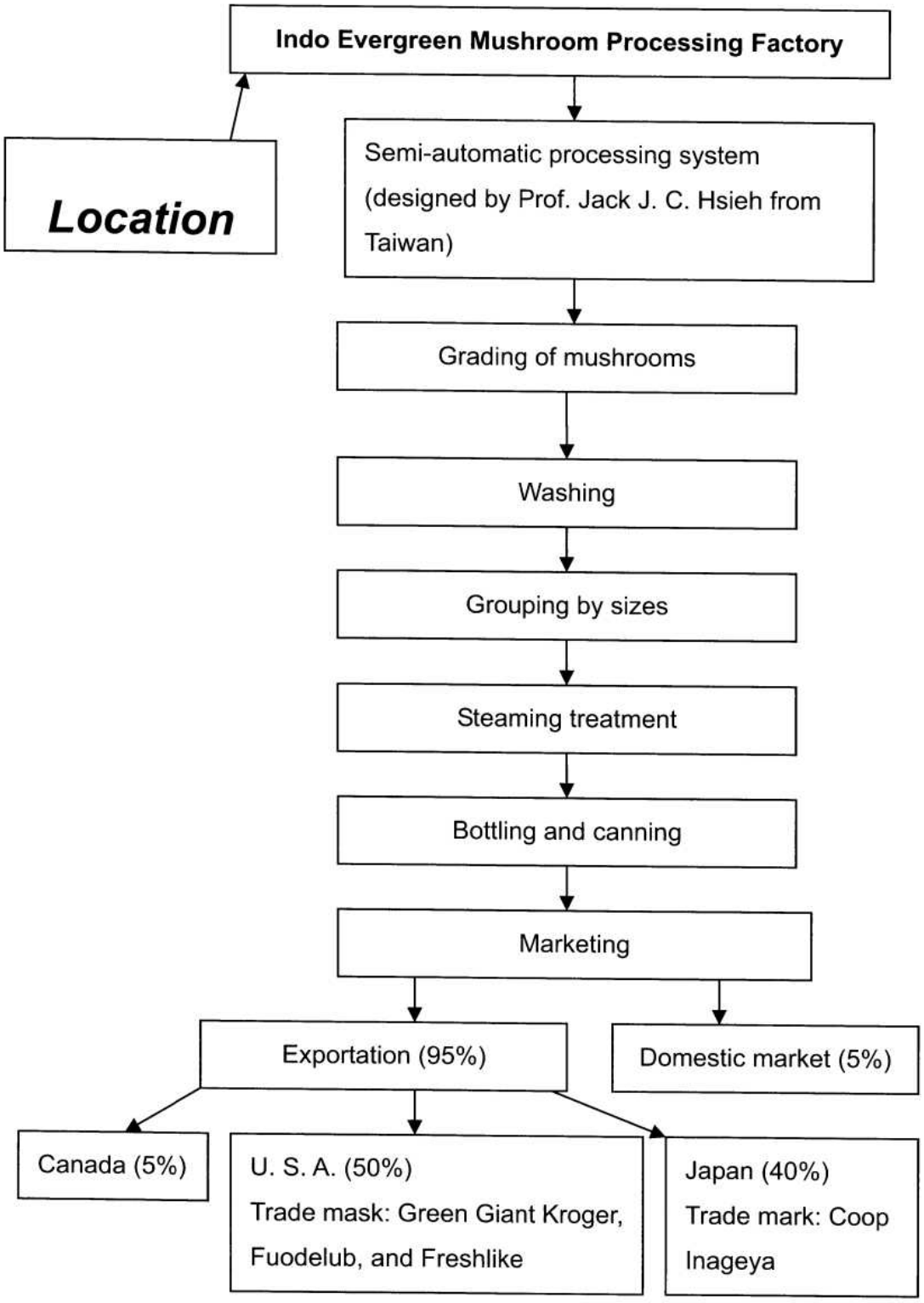

Indo Evergreen Mushroom Processing Factory
Location
Semi-automatic processing system (designed by Prof. Jack J. C. Hsieh from Taiwan)
Grading of mushrooms
Washing
Grouping by sizes
Steaming treatment
Bottling and canning
Marketing
Exportation (95%)
Domestic market (5%)
Canada (5%)
U. S. A. (50%) Trade mask: Green Giant Kroger, Fuodelub, and Freshlike
Japan (40%) Trade mark: Coop Inageya

Figure 4. Operation of mushroom processing and marketing of Indo Evergreen Company in Indonesia.

4. Transfer of wood-ear mushroom culture technology from Taiwan to Yogyakata province of Indonesia

Encouraged by the successful experience of the Indo Evergreen Company, the government of Indonesia wishes to develop the technology of culturing other kinds of mushrooms for extension to other districts. Based on Article 1 of the MOU signed in 1995, the ROC on Taiwan agreed to help farmers in Yogyakata province develop mushroom production industry. Mr. Yeh-hsuen Yu, a mushroom expert from the ROC-ATM was assigned to station at Sleman County of Yogyakata Province to carry out the proposed project. With financial support from the ROC-ATM, Mr. Yu set up a training center at Ngipiksari in Sleman. The Center has a laboratory with equipment, mushroom culture houses, and other facilities.

Mr. Yu introduced various kinds of mushrooms from Taiwan and other sources such as common white mushroom (*Agaricus bisporus*), wood-ear or ear mushroom (*Auricularia avaicula*, Hook), abalone mushroom (*Pleurotus ostreatus*), shitaka (*Lentinula edodes*), and ling-zhi (*Ganoderma lucidum*). He was able to culture all of the mushrooms, using the plastic bag method. The plastic bags are 40 cm in length, 13 cm in width, 0.6 cm in thick. They are filled with culture medium, which consists primarily of sawdust and other nutrients such as rice bran. The filled plastic bags are then sterilized under high temperature (98-100^{o}C) for 5-8 hours. After cooling, the mycelia of wood ear fungus are inoculated on the top of the culture medium, and then the opening part of the bag is tied. The inoculated plastic bags are then placed in a culture room at a temperature of about 20-24^{o}C and at 70% relative humidity. After the mycelia are fully-grown inside the plastic bags, the tightened parts of the bags are then cut off to allow the fruiting body to come out gradually. After the fruiting body is grown up to a proper size, it can be harvested. The harvested wood-ear mushrooms can either be sold in fresh or dried for selling at a later date.

(1). Extension of wood-ear mushroom

After the successful development of culture technology of wood-ear mushrooms, Mr. Yu organized nine mushroom production-training courses for the local farmers in Sleman County. A total of 482 farmers participated in the courses. One hundred and fifty-two people attended three additional courses from other regions including college professors, extension officers, and farmers. The participants received training on various subjects including microscopic identification of fungus strains, isolation and culture of the selected fungus strains from the impure fungi, methods of preparing culture media; method of preparing plastic bags, management of mushroom culturing houses, harvesting and drying wood ear mushrooms.

In addition to the classroom lectures, the participants were asked to perform each step of the culture in order to get hands-on experience. With this training, they could independently operate their own farms after they returned to their homes. The farmers received instructions from Mr. Yu from time to time taking advantage of his frequent visits to each farm. Because of its relatively easy practice and high profit, wood ear mushroom culture has spread quickly in Sleman County.

(2). Extension Sites

The following townships were selected as the primary sites for wood ear mushroom extension: (1) Gambretan, (2) Cangkringan, (3) Turi, (4) Kalizrang, and (5) Kepoharjo. The five townships are located at 700-1,000 m above sea level with temperatures ranging from 17 ^{o}C to 29 ^{o}C. This environment is especially suitable for growing wood-ear mushroom year-round. There was also another reason for choosing these townships. These towns are situated on the mountain slope land, which is not suitable to grow crops due to its poor soil condition and lack of water supply. Job opportunity in this area was scarce, and was rated to be the poorest mountain villages in Yogyakarta Province. This region was chosen with the hope, that the living standard of the inhabitants there could be improved after growing wood-ear mushroom.

(3). Organization of Production and Marketing Teams for Wood-Ear mushrooms

Production and Marketing Teams (PMTs) have been proven to be the most efficient way to promote crop production in Boloyali. Similar systems can also be established in wood-ear mushroom production. Up to 1999, Mr. Yu organized a total of 12 PMTs in Sleman County. Each team consisted of 40-50 farmers. Each farmer constructed 1-4 mushroom culture houses and a total of 980 cultural houses were constructed. A team leader was elected for each team. The team leaders made plans for production and solved technical problems with help from Mr. Yu and county extension officers.

(4). Process of Extension Work

First stage (Demonstration stage):

The ROC-ATM 100 percent subsidized the cost of constructing four mushroom culture houses for selected farmers, to serve as demonstration farms. The wood-ear mushroom mycelia inoculated plastic bags were given to the farmers by the ROC-ATM free of charge. The well-trained farmers took care of the wood-ear mushroom houses with productive results. The harvested wood-ear mushrooms were directly sent to the supermarket with the help of Mr. Yu and earned high profits. The profits from the sale of wood-ear mushroom produced from one cultural house (78 m^2) were equivalent to the profits of rice harvest from one hectare of rice field per year. Because of this high profit, the neighboring farmers quickly joined the team to grow wood ear mushroom.

Second stage:

Eight mushroom culture houses were constructed with subsidies 50 percent from the ROC-ATM, but no subsidies were given to buy the mycelia inoculated plastic bags. The farmers had to buy the plastic bag from the ROC-ATM.

Third stage:

No subsidies from the ROC-ATM were provided. Farmers paid all expenses for the 623 mushroom culture houses and the plastic bags.

(5). Process of wood-ear mushroom culture and marketing

Preparation of seed fungus mycelia

The ROC-ATM is responsible for propagating the pure seed strain of the selected stock fungus (F1) at the Ngipiksari Training Center. The stock fungus strain is supplied to the Seed Fungus Propagation Center. The Center multiplies the stock strain into secondary (F2) and tertially strain (F3) in glass bottles (or plastic bottles). These bottles, which contain the seed mycelia of ear mushroom, are then sold to the plastic bag producers as the inoculums, at the price of 1,000-1,500 rupiahs per bottle.

Production of wood ear mushroom fungus inoculated plastic bags

Under Mr.Yu's supervision, the plastic bags that contain wood ear mushroom fungus inoculated culture medium are produced. The rate of contamination is controlled at less than 5 percent.

Supply of plastic bags to the growers

Farmers buy the plastic bags at a price of 500 rupiahs or US$ 0.067 per bag from the supplier, and place them in their own culture houses. After the profuse growth of mycelia in the bags, the fruiting bodies come out. The fruiting bodies are then increased in size to be harvested. The harvested wood-ear mushrooms are then dried and stored.

Marketing of the dried wood-ear mushroom through Farmer's Cooperatives and Trade Companies

The dried wood-ear mushrooms are then packed and separated into different grades, 6 kg per package. The Farmer's Cooperatives buy the packed wood ear mushroom at different prices, according to the different grades. The trading company buys the dried wood-ear mushrooms at a price of 21,000 rupiahs per kilogram (US$ 2.8/kg) for the first grader; 20,000 rupiahs per kilogram (US$ 2.6/kg) for the second grade; and 18,000 rupiahs per kilogram (US$ 2.4/kg) for the third grade. Each of the four steps earns a reasonable profit; therefore everybody is satisfied with this production and marketing scheme.

(6). Economic analysis of wood ear mushroom production in Indonesia

The plastic bags that contain culture medium and the inoculated fungus are the primary force behind wood-ear mushroom production. The used plastic bags should be replaced with new ones after each round of production. Production of plastic bags requires special technology and certain facilities; therefore experienced experts and dealers usually handle this task. It is not difficult for farmers to buy the plastic bags from a plastic bag-processing center. According to Mr. Yu (1999), the cost of plastic bag per package is 309.88 rupiahs (US$ 0.041). One package of plastic bag is sold to the farmers at a price of 500 rupiahs (US$ 0.067). The plastic bag-production center earns 190.12 rupiahs or US$ 0.025 per bags (Table 9).

Table 9. Cost of plastic bags containing culture media and wood-ear mushroom seed fungus

Material	Cost per bag (Rp)	Percentage (%)
Sawdust	42.00	13.60
Plastic bag	44.00	14.20
Rice bran	45.45	14.70
Plastic cap	40.00	12.90
Fuel	24.54	7.91
Calcium carbonate	0.45	0.15
Cotton	5.00	1.60
Labor	65.40	21.10
Seed fungus	18.50	5.97
Chemicals for sterilization	4.54	1.50
Others	20.00	6.45
Total	309.88 (US$ 0.041)	100.00

Exchange rate: US$ 1: Rp 7,500

Source: Y. H. Yu and S. L. Lee (1999).

The total cost for the running one cultural house is US$410. This includes compensation for use of the culture house, cost of plastic bags, labor costs and other related expenses. A total of 300 kg of dried wood-ear mushrooms are produced from 5,000 plastic bags in one round of culture in one culture house. The gross income per house from sales of the product is US$ 800 per cultural house. The net income from one cultural house is US$ 390. Since wood-ear mushrooms can be cultured twice a year, a net income per cultural house per year is US$ 780 (Table 10).

Table 10. Cost and net profit return from culturing wood-ear mushroom in culture houses of $78m^2$ (6 m x 13 m holding 5,000 plastic bags)

A. Gross income:	
Ear mushroom yield per house per cycle: 5,000 bags x 0.06 kg	= 300 kg
Gross income per culture house: 300 kg x $ 2.67	= $ 800
B. Expenditure (cost):	
Compensation cost for 10 culture cycles in 5 years	= $ 20.00
Cost of buying fungus inoculated plastic bags: 5,000 bags x $0.066	= $ 330.00
Labor costs for harvesting etc.: 50 worker x $0.93	= $ 46.67
Others	= $ 13.33
Total cost per culture house	= $ 410.00
C. Net income per house per culture cycle : $800 – $410	= $ 390.00
D. Net income per house per year (2 culture cycles):	= $ 780.00

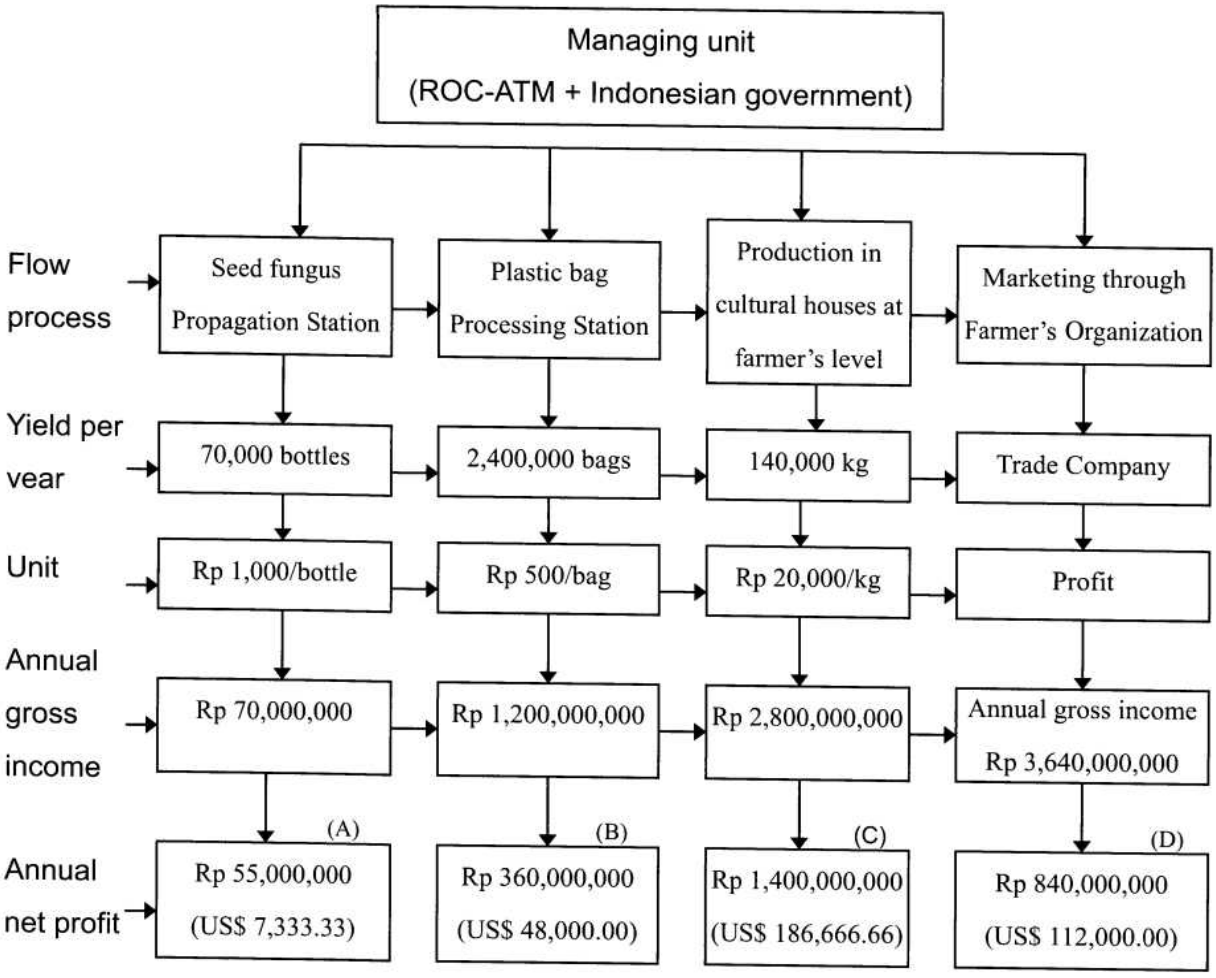
Source: Yu Y. H. and S. L. Lee 1999.

The wood-ear mushroom production and marketing flow chart with regard to the cost and return of each process was summarized in Table 11. As indicated in Table 11, four operational units are involved in production and marketing: (1) seed fungus propagation farm, (2) plastic bag processing farm, (3) production at the cultural house, and (4) the marketing unit of farmers' organization. The seed fungus stations produced a total of 70,000 bottles of seed fungus. The stations gained a net profit of US$ 7,333.33 (55,000,000 rupiahs) from the sale of seed fungus containing bottles to the plastic bag processing station each year. Using this seed fungus, the plastic bag processing station processed a total of 2,400,000 plastic bags containing inoculated mycelia. They were sold to farmers at a price of 500 rupiahs per bag and earned US$ 48,000 (360,000,000 rupiahs) net profit per year. The wood ear mushrooms produced by the farmers each year amounts to 140,000 kg, which was sold at a price of 20,000 rupiahs (US$ 2.66) per kilogram, with a net profit of US$ 186,666.66 (Rp 1,400,000,000 rupiahs). The produced wood ear mushrooms were collected by the farmers' organization and sold through the trade companies. The company sold at a profit of 25-35 percent and earned a total net profit of US$ 112,000,000 (840,000,000 rupiahs). The total net profit of above mentioned four units' amounts to US$ 354,000 (2,655,000,000 rupiahs). This is a huge sum of money for the farmers living on the remote mountains in Sleman County. More importantly, this project offered 2,500 job opportunities for the poor people in the area.

As mentioned in the previous paragraphs, any farmer who has a wood ear mushroom culture house of 78 square meters in size has the potential to gain a profit of US$ 780. This is equivalent to the profit gained from the rice production from one hectare of land per year. The plastic bag processing station is currently operated by the ROC-ATM. The total net income from the operations of this station totaled at US$ 4,441.92 (333,141,374 rupiahs) in

December of 1998. The money was deposited into a revolving fund, which in return is used to subsidize the businesses training expenses. The revolving fund was also used to invest in another plastic-bag processing station with a capacity of 120,000 plastic bags per year at Gondarg Township, in the Mojokerto County of East Java Province. This project will be operated as a joint venture with a local church foundation, to improve living standards of the people in that region.

Table 11. Cost and profit returns of each of the four units in charge of production and marketing of edible mushrooms, jointly managed by the ROC-ATM and the Indonesian government



Notes:

(1) (A) + (B) + (C) + (D) 2,655,000,000 Rupiahs (US$ 354,000.00)
(2) Exchange rate US$ 1: 7,500 Rupiahs
(3) Labor cost 200,000 Rupiahs/month/person
(4) Total employment under this project: 2500 person
(5) Source: Y. H. Yu and S. L. Lee (1999)

(7). Improvement of farmers' living standards after the implementation of the wood-ear mushroom production project

The farmers who participated in the project of wood-ear mushroom production increased their income within a short period of time. The farmers were able to buy their own new houses, new bicycles, and new furniture. The living conditions improved greatly. Two examples are illustrated in the followings:

1). Mr. Wagiman lives in Gambreton village. He used to work at the ROC-ATM as a temporary laborer with a monthly wage of 180,000 Rupiahs (US$ 24). He left the ROC-ATM and joined the wood-ear mushroom production project by establishing his own small-scale plastic bag processing station, which produces 1,400 bags a day. He started with 2 mushroom culture houses, which grew to 11 houses. The monthly net profit from the sale of plastic bags amounts to 9,000,000 Rupiahs or US$ 1,200, which is 50 times more than the wages he earned, previously from the ROC-ATM. Mr. Wagiman's annual income is now around US$ 14,400. Recently he was able to build a modern house with new furniture and buy an automobile. He is appreciates the wood ear mushroom culture project, headed by Mr. Yu.

2). Mr. Tarman, 34, lives in Kaliurang village. He used to be a bus driver with a monthly salary of 300,000 Rupiahs (US$ 40). Seven years ago he wanted to get married, however, because he lacked savings, he was unable to. He decided to earn more money through other means, so he participated in the mushroom production training courses organized by Mr. Yu in 1997. After participating in training, he built 2 mushroom culture houses under the support of Mr. Yu. He earned 11,000,000 Rupiahs (US$ 1,466.66) from the sale of wood ear mushrooms within a short period of time. With this money, he married within the next year (May 1998). He and his wife now have a young son and people in the town called his wife "Istri Jamur Kuping", which translates as "Mrs. Wood-ear mushroom". In addition to wood-ear mushroom production, Mr. Tarman is now operating a seed fungus (Auricularia auricula, Hook) propagation station, which requires more advanced technologies. With Mr. Yu's guidance, Tarman's station is now producing "seed fungus bottles" to be sold to the lower stream plastic bag processing stations. The monthly profits from the sale of seed fungus bottles from the station are 6,500,000 Rupiahs (US$ 866.66) and annual earnings are approximately 78,000,000 Rupiahs (US$ 10,399.99). This is a great deal of money for a farmer in Indonesia.

Conclusion

Agriculture is the mainstay and the largest sector in Indonesia's economy. It represents about 35 percent of total GDP and employs around 63 percent of the work force. Rural development has been the primary task of the government in Indonesia. Agricultural extension work is important in the development of agriculture in the rural areas.

Three successful cases of transfer of agricultural technology from Taiwan to Indonesia were discussed in this paper. The first case concerned the transfer of technology for the establishment of a production and marketing team for asparagus production in Boloyali County in Central-Java Province. Two locations (Teras and Cepogo Townships) were selected to set up two respective demonstration sites. Various kinds of vegetables, including asparagus, were introduced from Taiwan for trials. An asparagus expert, Mr. Kung-chu Wu from the ROC-ATM, was assigned to lead the asparagus project. Mr. Wu organized 116 farmer's households into six production and marketing teams and trained them with various technologies. A total of 1,258 farmers participated in 35 courses organized by Mr. Wu. The farmers were able to grow the newly introduced cash crop (asparagus) and gain a profit of from US$ 3,332.8 per ha of land in the first year to US$ 4,306.4 in the second year. The farmers earned US$ 4,982.0 in the third year. With the joint effort the ROC experts and Indonesian officials, a unit supervising the marketing of asparagus and other vegetables for Boloyali County was established to help with the smooth transfer of produced commodity to local market as well as foreign markets.

The second case of technology transfer was the agribusiness scale production and marketing of common white mushrooms in Indonesia by the Indo Evergreen Company. Mushroom-growing technology was transferred from Taiwan, while large-scale composting technology was transferred from Belgium. Because its success, the Indo Evergreen Company is able to produce 30 metric tons of processed mushrooms everyday. Ninety-five percent of the product is exported to North America and Japan and the remaining 5 percent are sold in Indonesia. The Company created 800 job opportunities for the local people. This is a very successful case of agricultural technology transfer from Taiwan to a Southeast Asian country.

The third case studied in this paper is the transfer of wood-ear mushroom culture technology from Taiwan to farmers in Sleman County, Yogyakata Province. Mr. Yeh-Hsuen Yu, a mushroom expert from Taiwan was sent to Ngipiksari Township, Sleman County. He was able to develop many kinds of mushroom-culturing technologies introduced from Taiwan. Among these, wood-ear mushrooms were chosen as the primary commodity for extension in Sleman County. Four sites (Gambretan, Cangkringan, Turi, Kaliurang, and Kepoharjo) in Sleman County were selected as locations for the development of wood ear mushroom

industry. A total of 12 teams were organized for the integrated production and marketing of wood ear mushrooms. A total of 40 mushroom culturing houses were constructed with the help of Mr. Yu. The extension work for wood ear mushroom production was carried out in 3 stages. During the first stage the ROC-ATM subsidized the entire cost for the construction of four culture houses. In the second stage, 50 percent of the cost of constructing eight culture houses was subsidized. In the third stage, no subsidies were provided to the farmers for the construction of 623 culture houses. Four processes are involved in wood ear mushroom production and marketing: (1) production of seed fungus growing bottles by the ROC-ATM, (2) production of wood ear mushroom fungus inoculated plastic bags, (3) supply of plastic bags to the growers, and (4) marketing of the dried wood ear mushrooms through Farmers' Cooperatives. The seed fungus stations at a value of US$ 7,333 produce a total of 70,000 bottles of seed fungus annually. The plastic bag processing stations produced a total of 2,400,000 plastic bags containing the inoculated mycelia. The net profit from the sale of the bags totals US$ 48,000 annually. The farmers earned a net profit of US$ 186,666 from annual wood-ear mushroom harvest. The marketing companies earn a total of US$ 112,000,000 from selling the product. The combined profits of the above four units amount to US$ 354,000 per annum. Because of the high profits, the farmers' living standards have been greatly improved.

Indonesia has a very good natural environment for growing various kinds of edible mushrooms, including wood-ear mushrooms. Wood-ear mushrooms are easy to grow and the market demand for this commodity is high in Indonesia. Therefore there is great potential for developing the mushroom industry. In general, the cost of processing plastic bags, which are filled with the wood-ear mushroom culture medium, occupies 80 percent of the production cost. Currently, the cost of preparing one plastic bag in Indonesia is only US$ 0.041, which are only one third of that in Mainland China, and one sixth of the cost in Taiwan. The Indonesian industry is very competitive with the principal wood-ear mushroom exporting countries, including China and Taiwan. The ROC-ATM's plastic processing station produced 120,000 bags per month in 1998. However, the amount was far less than what was needed. In view of this, Mr. Yu is now in the process of guiding potential investors in the establishment of nine more similar plastic bag-processing stations. Farmers and dealers in each step of production and marketing earned a pooled net profit of US$ 354,000 each year. This is truly a success story.

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Global Vision for AVRDC the World Vegetable Center[1]

Thomas A. Lumpkin[2]

ABSTRACT

AVRDC, as the world's principal international research center for vegetables, has continued to expand its impact globally by introducing and disseminating improved varieties and germplasm, production technologies, training methods and socioeconomic analysis to its partners and farmers. Focusing its research on major vegetable crops as well as promising indigenous vegetables, AVRDC has started to move from addressing production problems which afflict only those small-scale farmers located in the tropics to now meeting the challenges faced by farmers in all areas that suffer from chronic poverty and malnutrition due to war, severe weather conditions, diseases such as HIV/AIDS, or which have been bypassed economically. While cereal production has stabilized since the Green Revolution, new challenges exist for populations in the developing world to improve their food security, increase their levels of micronutrients, reduce the effects agriculture can have on the environment, and take advantage of opportunities in a global economy which is increasingly knowledge-based. The Center's future strategy for accomplishing this mission will be an expansion of its research capacity, both at its global headquarters and its regional centers located in Africa and Southeast Asia. AVRDC will continue to make use of technologies that will help farmers improve their incomes while protecting the environment, including biotechnology and organic agriculture. To get its information into the hands of partners and farmers who need it most, a greater use of information technologies and increased usage of regional vegetable research networks will be undertaken. This includes greater partnership with the private sector, where mutual interests and complimentary strengths hold promise for helping improving the lives of the poor. The result will be to observe in other areas of the developing world similar increases in vegetable production and yield that have been experienced in South and Southeast Asia over the past twenty years. Such successes have meant a greater supply of high-value; micronutrient-rich vegetables that have helped build economies and reduce malnutrition.

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Technology Transfer Methodologies and Their Consequences for Rural Development[1]

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ABSTRACT

Efficient transfer of agricultural technologies to farmers, which is the principal function of extension services, is a key for rural development. To achieve the objective of technology diffusion, effective technological information delivery methods, which are basically educational, should be found. There is quite a range of educational methods available for individual and group situations, as well as the mass media. With the development of electronics and information technologies, more-sophisticated methods are also emerging. The characteristics, and pros and cons of the various methods commonly adopted by extension services are explained in this paper to enable the selection of suitable technology transfer methods.

Introduction

The primary function of extension (agricultural technology transfer service) is the education of farmers. A substantial number of proven educational methods or techniques exist from which extension workers may choose. They are all intended to set up proper learning situations and to maximize the transfer of information and skills to both young and adult learners. Once the needs of an extension area or target community have been identified, it is the task of extension workers to choose suitable teaching methods that will be most effective in achieving their educational objectives. It is the purpose of this article to identify and explain various teaching methods commonly used in individual and group situations.

People learn better through their own activities, whatever they do. Before choosing a teaching method, the following points should be considered.

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(1) No single method is better than others. The extension worker should choose those techniques best suited to the situation. No one technique is considered superior to another.

(2) Use a number of methods to carry out a program. Experience in extension has shown that the more ways new information is presented, the faster an individual learns.

(3) Methods overlap. It is anticipated that some methods can be used simultaneously for strengthened effects. If a demonstration stimulates group discussion, then different methods can be applied to reinforce the information contained in the demonstration.

(4) Use audio-visual aids and written material whenever possible, as they reinforce and support teaching.

The dissemination of information on agricultural technologies and the stages through which it passes have been called the "diffusion process". It is part of the process of communication, by which an idea gets from its source of origin to the place of ultimate use. It is primarily a description of the mental processes that take place.

There are five clearly defined stages of development.

(1) **Stage 1 (Awareness)**. At this stage, people merely know that an idea exists. They lack details. This is somewhat like seeing something without attaching meaning to it.

(2) **Stage 2 (Interest)**. In this stage, a person seeks more-factual information about an idea. He/She wants know what it is, how it works, and what its potential may be.

(3) **Stage 3 (Evaluation)**. By now, the individual shows a marked interest in the idea as it applies to him/her and his/her operations or family. He/She asks whether he/she can do it, how he/she can do it, or it is better than what he/she is doing now. All these questions flood the mind.

(4) **Stage 4 (Trial)**. By now the individual has weighed the advantages and risks involved, and if the idea is divisible into small segments, is willing to try it on a small scale.

(5) **Stage 5 (Adoption)**. The final stage of the diffusion process is characterized by large-scale and continuous use of the idea. In large measure, there is satisfaction with the practice. These are the stages that extension workers always fulfill by suitable methods of technology delivery for target farmers, as explained below one by one.

Personal Contact

A. Individual techniques

Extension workers, interacting on a one-to-one basis with people, are utilizing an individual method of education. Although this approach is time-consuming, its importance cannot be overlooked, because it is through working individually with clientele that an extension worker learns about the people of the area, how they think, what their needs are, and how they carry on their work. Equally important is the opportunity that individual contact provides to local citizens. They get to know the extension worker, so that a personal bond between the extension worker and the community is established. It is through the use of this method that the extension worker's credibility and integrity can be nurtured. These methods are widely used and have been found to be highly effective when dealing with illiterate farmers working smallholdings who are not normally exposed to other educational techniques.

Method 1: Farm and home visits by extension workers

The farm and home visit method involves meeting individually with a farmer or farm worker at his/her farm or home. A farm and home visit serves a number of purposes: (1) to establish contact with men and women farmers and with others within the farm household, (2) to learn what practices and problems exist on farms and in farm households, and (3) to provide information and assistance. This technique is costly in terms of time spent and the number of clients contacted, which will necessarily be few. However, the benefits are sufficiently great to make this a highly recommended technique. The extension worker should visit many different farms and homes, and care should be exercised to visit with both men and women farm managers as well as other members of the farm family.

An illustration of the effectiveness of the farm and home visit technique occurred in Venezuela. A female extension officer worked with the women of an island village. She walked through the village stopping and talking with the women about everyday matters. As a result of the visits, the extension worker became aware of the daily routine of village life and of the role the women played in the traditional food supply system. She suggested expansion of the gardens traditionally kept by the women for the purpose of selling any additional produce as a commercial venture. When the idea was discussed in informal meetings, the village women asked the extension worker for new seeds and seedlings from which commercial production could be initiated. The potential for improvement in the village economy was made possible through the home visits and informal meetings. The groundwork was also laid for additional extension work, such as teaching better methods of cultivation. As with any educational method, careful planning and preparation should be carried out. The

following procedure is suggested.

<Before the Visit>

(1) Obtain or prepare a community map. A map showing where each family lives or works will assist the worker in planning area visits. In densely populated areas where visits to all clientele are not possible, the location of individuals or families already visited should be marked on the map. The map will enable the extension worker to plan visits efficiently in terms of time and mileage.

(2) Prepare and review the visit record. A visit record should be maintained. It should contain the date each client was visited, and the notes describing the purpose and activities of the visit. When planning a follow-up visit to the client. The visit record should be reviewed to refresh the memory.

If a visit to a new client is planned, the visit record and map should be consulted to learn if prior visits have been made in the vicinity. The review will help define the exact objective to be accomplished by the visit.

(3) Maintain an activity calendar. The extension worker should always plan in advance. Maintaining a list of activities and objectives on a calendar, which can be easily carried, is highly recommended.

<Conducting the visit>

(1) Greet the farmer and members of the farm family upon entering the farm or home and accept any hospitality offered, according to local custom. Spending some time talking with clients is highly recommended.

(2) During the visit, observe the conditions and activities of the farm operations.

(3) Discuss those observations with the farmer. Be careful if it is necessary to criticize something or suggest changes. When offering solutions, discuss what should be done and how the changes can be carried out. If additional information is needed, suggest a return visit.

<Follow-up>

(1) Make notes in the visit record and record the location on the map.

(2) Prepare any additional information for the client. It is essential to fulfill such promises of requested information provision if the extension worker is to build and maintain trust.

(3) Respect the client's privacy, and do not discuss the family's business with others.

Method 2: Office call and inquiries by the farmer

This method is concerned with personal visits made by the clientele to the extension office, to seek information and assistance. A visit to the extension office is a statement of

confidence in the extension worker and his or her advice, and should be handled carefully. To encourage office visits, extension workers should consider the following.

(1) Place the extension office in a convenient location.
(2) Keep regular office hours, so that clients will know when the extension worker will be available.
(3) Provide a visitor's record book, so clients may register their visit and inquiries in cases of the absence of extension workers. The extension worker may contact the visitor at a later time.
(4) Keep the office neat, orderly, and attractive.
(5) Maintain an up-to-date bulletin board and have information materials readily available.
(6) Make a special effort to put the visitor at ease, especially if the individual appears to be shy in an unfamiliar environment. It may be necessary for the extension worker to ask questions in order to determine the visitor's concerns or questions.

Method 3: Informal contacts

Informal contacts are unstructured and/or planned meetings with farmers in an informal setting. Such meetings provide the extension worker with an opportunity to meet clientele in an informal situation, which facilitates the establishment of personal bonds, discussion of problems, and recommendations for solutions. Informal contacts can take place on the street, in the marketplace, or at local celebrations. These meetings often take place by chance and are casual in nature. An effective extension worker is skilful in utilizing such informal teaching situations. The Indian extension offices actively promote informal contact by organizing social days. The purpose of these social days is to encourage extension workers and administrative officers to meet villagers. The informal environment promotes discussion of village programs, and gives extension workers an opportunity to involve villagers in community projects.

Method 4: Model farms/farmers

The model farm/farmer method involves identification of a farmer whose farming methods and personal attitudes are superior, such that his or her operation can serve as a model for others to follow. The purpose of selecting a model farmer is to demonstrate good farming practices by emphasizing an outstanding local example, to persuade neighboring farmers to adopt better farming practices, and to create a learning situation. The model farmer technique will be most effective of course, if the individual involved is well liked and respected, and the observing farmers can follow his or her experiences voluntarily.

Korea has enthusiastically adopted the model farmer technique. The model farmer is chosen by the government to promote local farm initiatives. Once selected, the model farmer receives intensive instruction aimed at fostering a pioneering spirit dedicated to benefiting the

community. The model farmer receives full governmental cooperation and support. In effect, model farmers facilitate extension work by acting as volunteer civil extension workers.

Method 5: Field flags

A final recommendation concerns an individual communication technique to use when farmers are not at home or in their fields when the extension worker visits. This method, which was developed by Korean extension workers, functions as follows. An extension worker visits a farm plot to help the farmer identify plant diseases and harmful insects in a rice paddy. The results of the crop examination and recommendations for treatment, if any, are written down and placed in the pocket of a red vinyl flag that is attached to a thin pole or a stiff wire. The red flag is placed in the field where the farmer can easily find it. After reading the message, the farmer rolls up the flag and places it in the same location. The extension worker recovers the flag on the next trip to the field.

The obvious advantage in using this method is that the time and energy expended by the extension worker in traveling to the farm plot is not wasted, even if the farmer or farm family is not there. The extension worker may go ahead with his/her work, and then proceed with the next task scheduled for that day. As staff time is ordinarily limited, this technique can help the extension worker make more-effective use of his or her time.

B. Group techniques

Group teaching methods are more frequently used in extension work than individual teaching techniques. This is not surprising because an extension worker can reach more people by utilizing group techniques than is possible by following individual methods alone. This is an important factor when time and staff are limited. Group methods are especially effective in persuading the extension service's clientele to try a new idea or practice. A group decision to try a new practice, for example, is likely to carry more weight in an area than a similar decision made by an individual.

One category of group techniques discussed in this section includes the traditional, demonstration-based methods, which have been in many ways the cornerstones of extension work. The methods fall into a grouping which could be informally called "seeing is believing", because they include physical demonstrations of practices the extension worker wishes to promote, or exhibitions of the results of good farming practices. Examples of methods discussed include the methods demonstration, the results demonstration, field days, and field trips. Contests, important in youth-oriented programs, are also discussed. Informative and innovative meetings comprise another important set of group techniques. Types of meeting discussed include the more-traditional lecture, panel, seminar, and symposium in which, for the most part, the audience plays a passive role by listening to one or more presenters. While

this type of meeting can present a large quantity of information to the people attending, audience boredom and lack of participation sometimes hinder learning. To help overcome these problems, the next group of methods, the innovative meeting techniques, was developed. The purpose of the innovative techniques, such as brainstorming and buzz sessions, is to improve the effectiveness of group discussions and to stimulate audience participation. These techniques can be used alone. However, they are often incorporated with more-formal information meetings to enhance interest and learning.

The final set of group methods consists of simulation techniques. These techniques stimulate learning by actively involving the participants in exercises modeled on reality. Individuals using this method look at the society (reality) in which their clientele live. Various elements are selected from that reality, and a simplified model is put together which represents (simulates) that reality. The model, or simulation, can be put into a number of forms such as board games, open-ended scenarios for role playing, and descriptions of life-like situations or critical incidents requiring decisions or answers to problems. The purpose is to provide the participants with experience in real-life situations, which can ultimately lead to a greater understanding of their society and the role they play in it.

Experience can be gained without the real-life penalties exacted if a wrong decision is made. Simulation techniques have been used successfully in rural areas. Simulations were used for 5 years in Ecuador in a rural adult education program, and the methods have also been used in Asia and Africa. Simulation methods rely heavily on the training and ability of the instructor, who must not only choose and/or develop the techniques, but also must handle the discussion following the exercise in such a way that extracts and highlights all the various lessons generated by the exercise.

Some general guidelines on planning and conducting meetings are listed as follows.

(1) **Purpose:** The initial planning step is to identify the purpose of a meeting. Once the purpose has been decided upon, the extension worker should review all information that he or she has at hand about the subject.

(2) **Type:** Choose the type of meeting to best accomplish the purpose.

(3) **Plan:** Once the purpose and type of meeting have been established, planning for the meeting can begin. Such matters as the date, time, place, speaker (if any), publicity, number expected to attend, the desired set up (number of chairs, tables, visual aids, etc.), and how the meeting will be conducted should all be considered. Finally, determine how the meeting shall be evaluated.

(4) **Publicity:** Publicize the meeting well in advance. Include the following in any announcements: subject of the meeting; where, when, and why it is being held; and the speaker's name (if appropriate).

(5) **Holding the meeting:** Bear in mind the following facts; (a) the subject should be of interest to the audience, (b) the meeting should be started with a challenge, (c) ideas should be presented in a logical sequence with ample opportunity for questions and answers, (d) visual aids should be used whenever possible, and (e) after general discussion, a summary should be presented and conclusions drawn.

Method 1: Methods demonstrations

The methods demonstration shows a group or class step-by-step how something is done for the purpose of teaching new techniques and practices to extension clientele. A methods demonstration can show, for example, how to use a tool, a new planting technique to prevent erosion, or how to cook a newly introduced vegetable. Ideally, each individual attending the demonstration will have an opportunity to practice the new skill during the session. Usually, however, time does not permit more than a few to participate. The effectiveness of the demonstration depends, in great part, on the amount of preparation and planning. Because the results of the demonstration can be observed and sometimes practiced, this method is very effective in persuading clientele to try something new. A number of suggestions are given below on how to plan and conduct a methods demonstration.

At the planning stage for the methods demonstration, the following items should preferably be observed.

(1) Identify the problem to be solved. The focus of the demonstration should be on solving a problem that exists locally. A local individual or the extension worker can identify the problem through observations and knowledge of the area. The extension worker should consider involving local clientele in problem identification.

(2) Identify the skill to be taught. Once the problem has been identified, the extension worker must decide what skill to teach, and what educational objectives he or she wishes to attain. When going through the skills identification process, each proposed skill or method should be subjected to the following queries: (a) Is the skill important? (b) Can the people afford to adopt the skill? and (c) Are there sufficient supplies and equipment available to permit its widespread use?

(3) Gather information about the skill and study it thoroughly. The demonstrator (most likely the extension worker) must be familiar enough with the method to break it down into teachable segments.

(4) Involve clientele in the planning and presentation of the demonstration. By seeking the people's advice and assistance, local interest and level of adoption will be increased.

(5) Assemble material required to conduct the demonstration. The material should

include everything the farmer would need to apply the practice on the farm.

(6) Plan the presentation step-by-step, including an introduction and summary.

(7) Rehearse the presentation until it can be given with confidence.

During the demonstration, the following practices need to be observed.

(1) Schedule the demonstration at the most convenient time and place for clients. In some cases this may necessitate two demonstrations, one for men and one woman. In other situations, both men and women may attend the same demonstration if care is taken in scheduling.

(2) Arrange the audience so that everyone can see and hear the demonstration clearly.

(3) Introduce the demonstration by explaining why the new practice is important and what will take place at the gathering.

(4) Ask for assistance from the audience to help in demonstrating the various steps.

(5) Proceed with the demonstration step-by-step, answering questions and repeating difficult steps.

(6) Encourage members of the audience to attempt the new method during the meeting. If time allows, each individual should have an opportunity to practice the skill.

(7) Summarize the importance of the skill, the steps, and the supplies and equipment needed. Distribute illustrated literature, if available, showing each step.

(8) Evaluate the demonstration carefully, noting where the strengths and weaknesses appeared.

(9) Visit those clients who indicated an interest in the demonstration.

Method 2: Results demonstrations

The results demonstration teaches why a practice or input should be adopted by physically showing how a new or different practice compares with a commonly used local practice. This technique is often used in crop farming. The purpose of using the results demonstration is to prove that the new practice is superior the one currently being used, to persuade extension clientele to try the new practice, and to set up a long-term teaching situation.

An example of a results demonstration would be a comparison of two wheat crops, one with an application of fertilizer and one without. In cooperation with a farmer, two demonstration plots can be laid out in a field, side-by-side. In one, wheat is planted using local seed and local cultivation practices. Because the purpose of the project is to demonstrate the effect of using fertilizer, no fertilizer is used. In the second plot, wheat is also planted, and subjected to the same practices and conditions, but fertilizer is applied. Both crops are harvested at the same time. If all goes well, the fertilized plot will produce a substantially greater yield than the unfertilized plot, visibly demonstrating the tangible benefits of fertilizer

application.

A successful demonstration can produce positive results for extension workers by creating confidence in their judgment and ability. It is a technique extension workers new to an area might want to use to establish themselves in the community. The extension workers should consider the consequences if the new technique fails, however, and choose the demonstration carefully. A results demonstration is costly in terms of time, but if it is successful, it is an effective way to promote a new practice locally, and can open the way for further interactions with the clientele. The results demonstration requires careful and detailed planning to be successful and to obtain full educational benefits. The following suggestions may serve as a guide when planning to use this method.

At the planning of the demonstration:

(1) Identify the problem to be solved by the demonstration.

(2) Decide upon the objectives to be accomplished.

(3) Gather complete information about the proposed practice and study it thoroughly.

(4) Seek the assistance of the clientele in planning and carrying out the demonstration. Endorsement by local leaders will lend credence to the effort. Seek their recommendations about good possible host farmers.

(5) Develop a complete plan of work, clearly delineating each individual step and showing who has responsibility for each task.

(6) Select accessible demonstration plots that are centrally located and near a road so people can easily visit the site.

(7) Visit the host farmer and work with him or her to make sure that he or she understands the purpose of the demonstration and how it will be implemented. This step is essential because the host farmer will be answering most of the questions about the project, and will play a prominent and visible role during the entire project.

During the demonstration:

(1) Ask area leaders to cooperate in encouraging people to attend the start of the demonstration.

(2) Visit the demonstration site often.

(3) Use the demonstration site for meetings and tours during the life of the demonstration. Encourage the host farmer to describe the process.

(4) Keep records on both sites so the results at harvest may be compared. Detailed records maintained during the entire span of the demonstration will facilitate speaking about the process in meetings and elsewhere.

(5) Publicize the demonstration by the best methods available. Use newspapers and radio if available. If not, talk about the demonstration on market day, to informal contacts, and in meetings held for other purposes.

After the demonstration:

(1) Evaluate the process and results of the demonstration. This will be useful when using the method in the future.

(2) Provide follow-up information and training to interested clientele.

Method 3: Contests

Contests are based upon the principle of competition and community-oriented activities, in order to encourage participation and heighten practical agricultural skills. The purpose of holding contests is to provide farmers, especially young farmers, with powerful motivational forces and to offer opportunities to excel in specialized subjects and skill areas.

After periods of learning and practice in a community, individuals and teams demonstrate their proficiencies and talents before the public in contests involving such skills as crop and livestock judging, tractor driving, and weed identification, to name but a few. Offering awards and rewards encourages entering contests, shows, exhibits, and demonstrations. Extension workers assume coaching roles. These include offering instruction in the fundamentals of the contest and suggesting strategies for winning. Coaching implies total involvement. It requires many hours, special kinds of resource materials, practice sessions, and extra travel to attend the competitive events. Preparation for contests causes coaches and farmers to become a team with a close relationship.

Method 4: Field trips

During a field trip, a group travels to another location to observe agricultural practices, projects, or demonstrations not available locally. The trip may consist of one or more stops. The purpose of the field trip is (1) to provide first-hand observation of practices that might be of benefit to the farmer, householder, or farm worker; (2) to enable the group to interact with individuals knowledgeable about the practices; and (3) to present a fresh and different learning environment for both the extension worker and the clientele.

The destination of a field trip may be an agricultural experimental station, a farm, a home, or a community organization, such as a women's marketing cooperative. It is essential that the extension worker work with the group beforehand so they know what they are going to see, why it is important, and how much time they will have at each stop. If the host is going to discuss certain practices, make sure he or she clearly understands the objectives of the visit, what role the visit will play in the overall educational program, and the time available for the visit. It is also recommended that the extension worker assign a task to the group to be completed during the trip. For example, each group member could be given a few questions relevant to the visit site to answer. Finally, time should be set aside for a group discussion at the end of the trip. This will provide the leader with an opportunity to highlight important aspects of the experience, and give the group members a chance to compare notes and ask

questions.

Planning a successful field trip takes a great deal of time and trouble. However, it is one of the most effective teaching methods, combining, as it does, discussion, study, demonstration, and first-hand experience in real-life situations. The field trip can be a very effective tool in persuading clientele to try a new practice. Some suggestions in planning a field trip are given in the section below.

(1) Identify the objective of the trip. A field trip taken only to add variety to teaching methods will be of little value, and a waste of time and effort.
(2) Set aside adequate time to plan the trip. The trip necessitates coordination of many factors such as people and transportation, over long distances, and with limited time. Allow enough time to complete all the necessary tasks.
(3) Contact site operators to obtain permission to visit. Identification of hosts and destinations may be decided upon with assistance from local leaders.
(4) Secure transportation. Decide early in the planning process how many people to plan for, what kind of transportation will be used, and whether it will be available for the dates in mind.
(5) Draw up a tentative schedule. Work with local area leaders to: (a) make out a timetable, (b) decide who will go on the trip (farmers, farm workers, and local leaders), and (c) learn what they believe should be gained from the trip.
(6) Finalize a detailed schedule and assign tasks to each participant. Steps (1) to (6) should be completed early in the planning period.
(7) Coordinate with site hosts to be sure that everyone clearly understands the time of arrival, the number of visitors, the purpose of trip, and their own role.
(8) Make a 'dry run' to ensure that the proposed itinerary can be completed in the allotted time.
(9) During the trip, keep groups moving to maintain interest and keep to the timetable. Provide for the comfort of the group to the greatest possible degree.

Method 5: Field days

A field day is a day or days on which an area containing successful farming or other practices is open for people to visit. Exhibits of a related nature such as tools, seed samples, and educational material are often displayed. The purpose of the field day is to permit extension clientele to personally observe and ask about successful farming practices, and to create a situation in which informal contacts and learning can take place.

Field days are normally held once or twice a year, usually in each crop season. They are held on farms, at experimental stations, or at government centers to demonstrate successful farming techniques or research. This method helps promote better farming by putting the best

agricultural exhibits on display, transmitting research results, and providing an opportunity for farmers to see and discuss the demonstrations with one another and with technical specialists. Exhibits and displays add another dimension to the experience. If the field day is held on a farm, it is recommended that the host farmer play a prominent role in discussing crops and practices. The extension worker should be available to clarify technical points. The following section contains some suggestions for planning and holding field days.

1) Planning a field day

(1) Identify the objective to be achieved.
(2) Select a demonstration site.
(3) Work with area leaders and the host farmer to decide on a date and on essential details of the event.
(4) Publicize the field day well in advance.
(5) Display signboards at the field day site.
(6) Arrange for an exhibition of related materials of interest to visitors. Where possible, include items that can be carried away by those attending.
(7) Arrange for transportation to carry the farmers and other visitors around the site. As with the field trip, arrange this well in advance.

2) Holding the field day

(1) Distribute literature describing the farming practices being demonstrated.
(2) Take visiting farmers around the plot. Conducted tours not only show consideration to visitors, but will help ensure they see the important points of the demonstrations.
(3) Let the host farmer explain the practices being demonstrated. This will show appreciation to the farmer for his or her extra efforts, as well as making visiting farmers feel more comfortable about asking questions.
(4) Emphasize distinctive features of the crops and/or practices being shown.
(5) Hold group discussions with participants about the practices being shown. Record their comments and reactions for use in the subsequent evaluation, and in planning future field days. Comments can be especially valuable in identifying what is, or is not, acceptable to the farming community.

3) Follow-up

(1) Evaluate the field day to determine its success or failure. Use the evaluation to help guide future field days and program planning.
(2) Contact farmers who indicated interest in the new practices and assist them in adopting it on their farms.

Method 6: Informal discussions

Informal discussions in small groups are another type of group technique. Neighbors get together in a certain house at a certain time period once a month, or perhaps once a week, to consider and communicate common public problems and to get acquainted with their neighbors, exchange farming information and ideas, and share common problems, in order to help each other and the community.

An informal discussion can be carried out at the villagers' monthly meeting. This discussion group cannot have professional leadership. The idea is that responsible villagers should get together to consider and talk about common problems. It is most successful in its pure form of government-assisted village and town work in developing countries, where the extension worker helps the community improve not only its own economic literacy levels, but also health, sanitation, and family planning. Through this type of discussion, extension workers can encourage grass-roots discussion of pubic issues, improve the quality of discussion, and form a common thought pattern.

Method 7: Lectures

Lectures are formal, verbal presentations by a single speaker to a group of listeners. Visual aids may illustrate the lecture, and a question and answer period may follow the talk. The purpose of the lecture is to provide a body of organized information to an audience. While the lecture is a systematic way to present information, a major drawback is the passive role of the listeners. Unless the speaker is gifted not only in his or her grasp of the subject matter but also in wit and style, attention tends to wander. Lecturers should be well organized, deal with one or two central themes, and make every attempt to obtain and keep the attention of the audience. High-quality visual aids are often useful. A lecture series, with lectures being presented over a period of time, can sometimes be used.

Method 8: Panels

Panels are moderated meetings in which a limited number of experts or specialists give short presentations on the same subject. Ideally, each panelist represents a different field or discipline.

A panel provides a group with a series of informed opinions on a given topic. Those attending a panel session have an opportunity to receive an in-depth view of a subject by hearing the various experts give their opinions, by observing the interplay among the panelists, and by having an opportunity to question them. A strong moderator should guide a panel with a gift for summation, to ensure that each panelist has enough time to give his or her presentation, and to oversee the question and answer period.

Method 9: Colloquies

This is a modified version of the panel, in which three or four resource people discuss a specific topic. The audience can express opinions, raise issues, and ask questions. The primary difference between a panel and colloquy is the degree of audience participation.

Method 10: Symposiums

Symposiums are meetings in which two to five resource people give short, prepared papers on a given topic. Interaction with the audience is not expected. The symposium is used primarily for information gathering at the professional level.

Method 11: Seminars

Seminars are comprised of a small group of students or trainees engaged in specialized study under the leadership of an expert. The leader may give a brief, opening presentation, often on provocative issues, and guides general discussion. Members of the seminar sometimes conduct research. The seminar is normally reserved for advanced study and provides an opportunity for in-depth study of an issue or a series of issues with an expert.

Method 12: Modified conference method

This method is a procedure in which a group of people, each of whom has some experience in connection with the job or problem at hand, comes together to discuss situations they are facing. This method provides those attending with an opportunity for constructive thinking under the stimulus of contributions offered by other participants.

Steps in the conference procedure are as follows.

(1) Define the job or problem under consideration.

(2) Analyze the job or problem.

(3) Select the functioning facts from the experiences given by members of the class.

(4) Assemble these functioning facts either on a blackboard or a chart.

(5) Evaluate the facts obtained in light of the problem.

(6) Submit any additional facts to be considered, such as data from experimental stations.

(7) Have each member of the group make a decision concerning the changes, if any, he or she can perform on their farm.

(8) Have definite working plans prepared for implementing the desired, improved farming practices.

(9) Supervise the making of plans. At a later date, visit each farm to check the results.

Method 13: Clinics

Clinics are meetings or series of meetings involving the analysis and treatment of specific problems. This method gives participants an opportunity to examine a problem or problems, with the goal of finding a solution. Those attending are also exposed to a process of analytical problem solving.

Method 14: Workshops

Workshops are cooperative gatherings of individuals who discuss, learn, and apply practical skills. Participants are trained in skills, procedures, or practices, which can be immediately utilized. Those attending are expected to produce a product, such as a visual aid, by the end of the meeting. The workshop normally involves between 15 and 30 people. Workshops can be a very effective teaching tool because the participants spend one or more days intensively working on a specific product. When properly conducted, this method gives practical hand-on experience, and is a widely used technique.

Method 15: Brainstorming

Brainstorming is a group discussion technique in which members generate as many ideas as possible on a specific topic without restraint or consideration of practical applications. Spontaneity and creativity are important parts of the process. The purpose of utilizing this technique is to promote group creativity, so that all aspects of a problem are considered. Input from each member is encouraged with the intention of a better product or solution being produced than might have been possible by an individual. Brainstorming gatherings should be restricted to fewer than 20 people per group. As ideas are presented, a recorder should write them down so everyone can see them. No judgment is made about the ideas during the session. Evaluation is made at a later session.

Method 16: Buzz sessions

This technique involves dividing a large group into much smaller ones, in which a topic is discussed within a limited period of time. Generally, buzz groups are expected to produce a product (such as a list of ideas, an opinion, or a group of questions) within about 5 min and to give an oral report to all groups involved in the exercise or meeting. The purpose of the buzz session is to facilitate the involvement of every member attending the meeting. This method is sometimes used to break up a larger meeting, and to add variety and interest. It can also be used to solicit solutions to problems, or to gather opinions.

Method 17: Discussion groups

Discussion groups are meetings or conversations between two or more people discussing a topic of mutual concern. Members of a group normally share a common

background, based on assigned readings or shared educational experiences. The purpose of this technique is to provide members of a group with an opportunity to gain a firmer grasp upon knowledge by setting up a situation in which questions, problems, and feelings about a topic can be discussed. Discussion is a versatile technique in that the group can assign a moderator, be given goals, or have an agenda to follow. To be a true discussion group, one of these elements must be presented to provide structure.

Method 18: Listening teams

Listening teams consist of individuals within a group who listen, take notes, form questions, or summarize a meeting such as a lecture, panel, or a colloquy. The purpose of the listening team is to facilitate interaction between a speaker and the audience. This technique is especially useful when the speaker is not knowledgeable about a group's or institutions specific problems.

Method 19: Simulation games

Simulation games are learning exercises in the form of games, which contain elements of real-life situations. Their purpose is to provide participants practice in dealing with real-life situations, in making decisions about them, and in observing and understanding any consequences of those decisions. The exercise seeks to promote discussion about a participant's own reality.

An example of a simulation game is "Shantytown", which was developed to model the situation facing recent rural immigrants to a city. The game can be played by two to six people. Each player is given a certain amount of money at the start. Play takes place on a board made with areas such as rent, salary, employment, food, bar, and other factors, which direct the player's actions upon landing on the area. Dice, cards (marked with instructions and consequences), and tokens are used.

As play proceeds, the dice are cast, and the players advance around the board encountering various circumstances, for example, "buy food", "pay rent", "go to jail", "employment", and so forth. The game is over when all but one (or all) players are forced to return to their village. The game is designed to inform rural people of factors they may never have considered when thinking about leaving their village. For example, the need to pay for housing and food needs may have been fulfilled without the use of cash in their village. A game like "Shantytown" opens up many points for discussion, and gives players opportunities to face real problems.

It is important to understand the culture or society before initiating game playing, because what is permissible on one culture, such as gambling, may not be so in another. Once a game has been chosen or put together, play it a few times and change it, if necessary.

Flexibility is important. Should a game need to be adapted, involve the clientele?

Method 20: Role-playing

Role-playing is a simulation in which a simple, open-ended scenario is described, and participants are assigned roles within the situation or problem to act out. There is no script to follow, and participants play the roles as they see fit, drawing on their own experiences. The purpose of using this technique is to involve participants in real-life situations, to stimulate thought and learning, and to encourage discussion about factors involved in the drama.

The scenario used to set up a role-playing exercise may be simple, but it must be based on the local reality. In planning this exercise, the extension worker should (1) identify a setting, for example the landlord's estate, (2) identify and assign roles, describing each to the players (for example, the landlord, two tenant farmers), and (3) specify a task or problem to be solved. For example, the tenant farmers are trying to convince the landlord to help them buy a new high-yield seed to increase production. Special emphasis should be put on the discussion following the exercise, and in helping the audience and the actors themselves to assess the points raised by the drama.

Method 21: Critical incidents

Critical incidents are an open-ended simulation technique in which each participant gives his or her own opinion about the outcome of a described situation. As in all the simulation techniques, the incident should be based on the local reality. In this exercise, a number of incidents can be used to promote discussion in which proposed solutions can be compared and discussed.

Method 22: Community training centers

While a school or village hall may be used for instructional purposes, the community will gain a sense of purpose and achievement if it undertakes to build a simple building of its own for use as a training center. It can be improved upon in the course of time, and it will help the extension worker if he/she has a small fund from which to purchase materials such as nails, cement, and fittings.

Method 23: Remote conferences

To hold important meetings among a disparate audience, there are three technologies available nowadays, even though they require expensive high-tech equipment: tele-conferencing, Web-conferencing (using the Internet to share files while talking on the phone), and video-conferencing (which can be combined in various ways with the other two).

None of the technologies is as good as race-to-face encounters, especially when the meeting crosses cultures, borders, languages, and time zones (in other words, when a

meeting is global). Yet when travel is not an option, one technology may work better than another for specific kinds of meetings.

Therefore, treat each technology as having a different kind of business use or purpose. If the extension worker cannot get the group of farmers together in person, he should run the meeting in a way that recognizes the limitations of conferencing technology.

As these technologies require heavy investment in IT facilities and equipment, users should make sure their investments are put to good, effective use. Therefore it is necessary to recognize where remote conferences, when conducted correctly, are genuinely more effective than the in-person alternatives.

Web-conferences were less effective than tele-conferences a few years back. Now, Web-conferencing technology has taken over with the rapid development of Internet technologies. Internet communication has become cheaper than telecommunication. Web-conferencing is optimal when a meeting is basically in the form of a broadcast, where one person does most of the talking, but there may be a few questions from listeners. The technology is also effective when the speaker works from a document such as a report or a PowerPoint presentation.

For global meetings, web-conferencing surpasses tele-conferencing for broadcasting purposes because differences in language or time zones are exacerbated with tele-conferences. With a shared document, the meeting can be more inclusive for a longer period of time. Conversely, if tele-conferencing is used for broadcasting, the meeting should accordingly be shortened.

To facilitate communication, there are three rules of thumb for using these technologies in a more-nuanced way.

(1) The more broadcasting there is in a meeting, the more appropriate tele-conferencing or web-conferencing is. But do not expect the broadcast to be as effective as in-person encounters.
(2) Conferencing technologies put a greater strain on participants, so make video-conferences or Web-conferences shorter than corresponding meetings would be, and involve fewer people.
(3) Do not expect any technology to substitute for travel. Remote participants in a Web-conference cannot take away from the encounter what they would if they were meeting in person.

There are times when a meeting demands real interaction, and video-conferencing is a viable solution. But be forewarned that the technology leaves a lot to be desired, particularly when an international crowd is involved. If using video-conferencing purely as a substitute for

an in-person meeting, everyone is forced to put in the same amount of time, and even more attention, than they would have put into a regular meeting. Video-conferencing works better when only a few people are involved and when the meetings do not have much formal structure. In essence, video-conferencing is fine when used by two people with Web cameras having a short conference, but it falls short when used by 20 people from three countries in an all-day marathon session.

The most important principle as far as suitable behavior in video-conferencing is to act as if you were in the same room as the speaker. Remember that the attendees might be seen as being much larger than life, because at some sites a person's image appears on a very large screen. Therefore courteous behavior should be observed at all times during a video-conferencing lecture or meeting, both to the speaker and participants at other sites. When the lecture is in progress, it is normally best to mute the other sites, so that any noises made do not interrupt the speaker, and then turn on the sound again when answering questions or otherwise participating in discussions. While remote conferencing technology can satisfy some global communication needs, accept the fact that the best way is to meet in person.

Mass Communication

Personal, face-to-face methods cannot reach everyone who wants and needs information. Such mass media methods as radio, newspapers, magazines, television, motion pictures, slide shows, exhibits, printed materials, and computers are used to reach large numbers of people quickly.

These methods are particularly useful in making large numbers of people aware of new ideas and practices, or in alerting them to sudden emergencies. While the amount of detailed information that can be transmitted by some mass media is limited, they can serve important and valuable functions in stimulating farmers' interest in new ideas. Once stimulated or made aware through mass media, farmers will seek additional information from neighbors, friends, extension workers, or progressive farmers in the area.

Some mass communication techniques that may be developed as part of a campaign to support other extension efforts are discussed below. They may be used singly or in combination, as needed, to meet the proposed objectives.

A. Print media

The term, print media, is used to cover those communication techniques that rely

principally on combinations of printed words and pictures. They are our oldest formal combination. To use them effectively the educational level and literacy rate of the audience must be considered.

Extension programs can take broad and creative approaches to ways in which to use print methods for conveying news to specific audiences. Newspapers may come to mind first, but they are only one of several types of printed mass media available to convey extension news and information.

The following points should be considered when preparing printed materials.

(1) When preparing printed materials, keep the audience constantly in mind. Write with words people understand. Write about things that interest people. Change the method of presentation as the proposed readership changes (young people, farmers, and women). Eliminate difficult scientific and technical terms where possible.

(2) The importance of illustrations cannot be overemphasized. Even where literacy is not a problem, people interpret words differently because of differences in past experience. Almost every extension service overestimates the ability of its audience to read a printed message and understand it clearly. Almost every extension service overestimates the extent which people will be attracted to and read a printed massage.

(3) Illustrations reduce the risk of misunderstandings: they help make your message clear and more attractive, and they increase learning.

(4) A good layout arranges material in a logical, easy-to-follow manner and makes it attractive to readers.

(5) Realistic illustrations are usually the most effective in extension work, although humorous drawings have a definite place. Use humor carefully so as not offend anyone. Good pictures make any publication easier to understand and more interesting to read, but crop unnecessary details from photographs, and keep drawings simple.

(6) Folders generally have more appeal when color or ink other than black is used. Choose colors that are legible as well as appropriate: dark green ink for pastures, dark brown for soils, etc. Two or more colors can be used if the extra cost is justified. Colored paper can also be used for interesting effects and is available at very little extra cost.

(7) Attractive, effective publications can be prepared on spirit duplicators, mimeograph machines, offset duplicators, or letterpresses. It is not difficult to train an artist to produce illustrations, headings, or even copy in the local dialect for each of these methods of printing.

(8) Recognize that the cover of the illustrated literature has a function different from the

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Transfer of Biocontrol Technology in Taiwan

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ABSTRACT

Applied biological control (biocontrol) involves the use and management of natural enemies of plant pests by humans. Its advantages over other types of controls includes its relative safety, permanence, and economy. One minor disadvantage is that a biocontrol program may take a long time to implement, because of the research and other efforts involved in setting it up. The best natural enemy is one that is an exceptional searcher and has high fecundity, and thus it is able to find the host or prey at very low densities and thus help maintain those low levels. The lacewing is a broadly used natural enemy. It preys on aphids, psyllids, mealybugs, whiteflies, spider mites, and the crawlers of scales. The lacewing Mallada basalis (Walker) is an indigenous species which is a natural enemy of spider mites, mulberry psyllids, and peach aphids in Taiwan. It has been successfully reared in great numbers using the eggs of the rice moth, Corcyra cephalonica (Stainton), as food and has been applied to biocontrol of spider mites on papaya and strawberry. The main extension method begins with a demonstration conference, and then individual discussion meetings are held with interested production and marketing groups to transfer the rearing techniques. Extension agents make continual follow-up visits to help group members solve technical problems during the period of technology transfer.

Introduction

A species population is "regulated" by the combined action of biotic and abiotic factors at a characteristic fluctuating level that is called natural control or the balance of nature. This fluctuation may vary from one geographic area to another, or may change with time in the same area as conditions change. The more diverse the natural communities are in an area, the greater the ranges of compensations which exist for preventing drastic upsets which may cause controlling agents to temporarily lose their effectiveness. Oversimplified agro-ecosystems create relatively unstable environments which give rise to a greater

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magnitude of variation in numbers of pests.

"Regulation" implies that fluctuation levels are restricted by density-induced factors called density-dependent factors, such as the properties of the species and natural enemies. On the other hand, climate, soil, and photoperiod are unrelated to density and are regarded as density-independent factors. These factors have the same effect on numbers regardless of the density.

The term "biological control" is commonly used to signify the use of natural enemies to control pests. An insect becomes a pest as a result of its escape from the balance of nature which exists in its native habitat, where living organisms have experienced long-term coevolution and are affected by similar biotic and abiotic factors. High population levels of an invasive insect can be reduced by a reconstitution of this balance in the new habitat based on the introduction and manipulation of its natural enemies. However, it is neither possible nor desirable with biological control to reconstruct the complicated interactions among pests and their natural enemies or the environment. Effective biological control requires that the pest population be regulated to an extent that it does not exceed an economic injurious level, or so that it can be reduced with some other form of integrated control methods. Therefore, one is concerned not so much with how a natural enemy actually performs in its native habitat as with its intrinsic properties and their expression in the new ecosystem. Once biological control is successfully established, it is often self-perpetuating at little or no cost, with no harmful effects to humans, plants, or other organisms. But special caution is required since the impact on the native living beings of introducing a foreign organism into a new ecosystem is difficult to indicate or forecast without greatly expanded research over a long period.

Is Biological Control Feasible?

In order to answer this, each of the following questions should be taken into consideration.

1. How much injury is tolerable?

This aspect concerns society's needs and desires. If consumers tend not to accept damaged products to the extent that little or zero damage is tolerated, then biological control is severely limited. Natural enemies cannot prevent all damage by a pest since they tend to interact with the pest at equilibrium densities.

2. What is the value of the crop?

The cost/benefit ratios may dictate the control method for a pest problem. In the control of pests or weeds on low-value cash crops, the introduction of natural enemies to self-regulate the system may be an economically viable approach.

3. Is the crop annual or perennial?

To achieve biological control of pests on annual crops is more difficult because of the instability of annual crop agricultural systems. Generally, pests invade the crop field before the natural enemies and have higher reproductive capacities. By the time the natural enemies have become established and begun to express their control effects on pests, the crop is ready to be harvested and could be damaged. Hence an inundatory release of natural enemies is necessary to control the pest in a timely manner much as insecticides do, but that increases the cost/benefit ratio.

4. Is the pest native or foreign?

If the pest is foreign, the first approach is to investigate the natural enemies that attack it where it naturally occurs. If it is native, the management of its existing natural enemies can be investigated along with the possibility of importing exotic ones.

5. Are there any effective natural enemies?

Whether or not one natural enemy by itself or several used in combination can maintain the pest population at below an economic injurious level is hard to predict. In some cases, because of the ecological homeostasis between a pest and its natural enemies, the possibility of introducing better control organisms needs to be considered.

6. How many pests must be controlled and what level of control is required?

If there are numerous pest species and damage tolerance is low for a crop, a wide scope of insecticides may be necessary, since the use of natural enemies to control some of the pest species can be too complicated to be economically studied.

7. Are selective insecticides or resistant natural enemies available?

The use of selective insecticides will help to conserve populations of natural enemies while killing the pest in the field. Other considerations for keeping the insecticides away from natural enemies include the careful use of dosage, timing, application, and formulation. Insecticide-resistant natural enemies can be obtained through a careful manual screening process and used in such situations that one or more pests must be controlled by frequent and/or heavy insecticide applications.

8. Has the same control program been successful in other areas?

The practice of biological control has essentially had an empirical, not a theoretical, origin. A similar successful biological control program can be expected against the same pests on the same crops under similar conditions.

Transfer of Biocontrol Technology

1. The lacewing

The young stages (larvae) of the lacewing look like small alligators and are voracious predators. Larvae prey on a variety of insects such as spider mites, aphids, whiteflies, mealybugs, thrips, leafhoppers, psyllids (jumping plant lice), and the eggs or young stages of lepidopterans and coleopterans. The larva uses its piercing mouthpart to suck out the body fluid of its victims. The emptied victim's body is then carried on the back of the larva to act as camouflage, as it looks like bird feces. In contrast, the adult lacewing feeds only on nectar and pollen. The entire life cycle is about 6 weeks, with the young stage ranging from 12 to 25 days. Over 20 companies worldwide supply lacewing eggs for the control of insect pests on strawberry, hops, pepper, tomato, lettuce, and ornamentals grown outdoors and in greenhouses.

Mallada basalis (Walker) is a native species of lacewing in Taiwan. Research on its biology and rearing techniques began in 1975. But techniques for its mass-rearing were not successfully established until a stable supply of the eggs of rice moth, *Corcyra cephalonica*, was available. The Taiwan Research Institute of Sugar rears copious amounts of rice moths and collects the moth eggs for the purpose of reproducing a *Trichogramma* parasitoid that is used for the control of corn earworms.

The Miaoli District Agricultural Research and Extension Station invented a new rearing technique based on years of research experience on this predatory lacewing. The larvae are fed with moth eggs in an insectary. The inside edges of the rearing containers (45 x 30 x 15 cm) for the larvae are painted with fluon (polytetrafluoroethylene, ICI) to prevent the larvae from crawling away. Adults are contained inside a transparent PVC cylinder, which has a sheet of white paper encircling the interior for egg collection. The entire cylinder is placed on a garden watering plate so that it can easily be moved around. The adults are fed with a mixture of yeast and honey, and a piece of cotton saturated with water in a film canister serves as a water source. A working table with a fan mounted underneath is used to manipulate the adults. The face of the fan is covered with a net and is mounted in the center on the same level as the table. The adults are immobilized on the net and cannot fly away, as the fan spins in reverse and draws them onto the net.

The lacewing was first released to control citrus red spider mite, *Panonychus citri*, on citrus on a small scale in 1991. It was later widely released for the control of spider mites on net-housed papaya and strawberry, and for aphids on lettuces and ornamentals. Researchers worked with farmers when studying the efficiency of a control agent on a specific crop grown within the Miaoli District. It takes a few years to confirm the effects of a control agent by itself or in combination with other control methods on a target pest.

The first step in transferring a successful pest control technique to farmers is to hold a demonstration conference to bring farmers together. In the conference, the participatory farmer describes what he has experienced with the use of a natural enemy for insect pest control on his crop. Researchers also play the role of extension agent to some extent. They later hold individual discussion meetings with interested production and marketing groups. Those group members usually grow the same crops or fruit trees. A member of the group is responsible for reproducing the natural enemy and then sells it to other members. At this stage, the Miaoli Station provides the stock source of biocontrol agents for the group to reproduce more individuals, that are later all released on crops for pest control. The central government provides subsidies for the food of the natural enemy through an extension program for biological control.

2. The predatory stinkbug

The stinkbug, *Eocanthecona furcellata* (Wolff), is a common predator on vegetable fields in Taiwan. Its biology and control potential for pests was first studied in 1971. It was also studied for controlling the young stage of leaf beetles in Meghalaya in 1996. The young stages of this predator can kill up to 22 caterpillars of the third stage of the Chinese cabbage butterfly every day. Each adult female killed 8 caterpillars of the third stage, while the adult male killed 5 caterpillars of the same stage every day.

This predator has been fed with armyworms, Asian corn borers, and rice leaf rollers, while the Miaoli Station has used the caterpillars of the Chinese cabbage butterfly, armyworms, silk worms, and maggots of the blowfly to feed this predator. The development period of the young stages ranges from 21 to 26 days. Since it is very convenient to purchase maggots from fishing gear stores compared to other food sources, they are used to feed this stinkbug in great numbers. The rearing containers are the same as those used to rear lacewings, so that the rearing costs for both predators can be reduced. The extension processes are the same as those of the lacewing. The Miaoli Station maintains a stock colony of this predator and provides egg masses to organic farmers.

Economic Benefits

During the peak extension period, more than 30 farmer associations adopted the lacewing as a biocontrol agent for spider mite control on papaya grown inside net houses. The cost per hectare for the conventional chemical application on papaya was NT$ 12,000 (US$ 1 ≈ NT$ 34), but it only cost NT$ 3,900 for releasing lacewings to control spider mites on papaya. As a result, using lacewing as a biocontrol agent for spider mites control on papaya can save a farmer up to NT$ 100,000 annually compared to chemical control. Using lacewing

on strawberry to control spider mites may be NT$ 6,000/ha less than conventional chemical control methods. Strawberry farmers can save NT$ 80,000/ha each year when they use lacewing instead of chemicals for spider mite control. In addition, the percentage of malformed strawberry fruit decreased 6.1%, and the highest-grade fruit increased 7.7% because of the more-successful pollination of flowers due to reductions in chemical applications. The strawberry farmers can increase their income by NT$ 20,000/ha each year. Using lacewing on leaf vegetables for the control of aphids can save the farmer NT$ 15,000/ha as compared with the cost of conventional chemical control.

Conclusions

It usually takes a long time for agricultural researchers to develop a practical technology for farmers. But for researchers, it may be even more difficult to successfully transfer the technology to farmers. First, the extension agent has to convince farmers that they can make a profit by implementing the new technology. Thus a demonstration farm has to be established on site. Second, the government has to provide incentives for farmers to implement the new technology. In Taiwan, in order to encourage reduced application of agrochemicals on crops, the central government provides subsidies for individual farmers to rear natural enemies as biocontrol agents. Research stations then provide free stocks of natural enemies for interested framers to reproduce more individuals to use in the field. Unfortunately, once the government withdraws the subsidies, some farmers are reluctant to continue to implement biocontrol strategies for insect pest control.

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Highlights of the Situation with Linkages among Researchers, Transfer Agents, and Farmers in Ghana

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ABSTRACT

The capacity of agricultural technology systems to establish and manage good linkages between researchers and technology transfer agents strongly influences the extent to which farmers end up gaining access to relevant and useful technologies. This report attempts to highlight the situation of linkages among researchers, transfer agents, and farmers in Ghana. Two examples of technologies (quality protein maize – QPM and conservation tillage) which are being transferred to smallholder farmers and how the farmers have embraced these technologies are discussed in this report.

Introduction

One of the biggest challenges now facing Ghana is to reverse the negative trend in agricultural productivity and the deterioration of the productive resource base. Access to more-productive and sustainable agricultural technologies by resource-poor farmers, who make up the majority of the farming community, is a prerequisite to meeting this challenge. For years, technocrats as well as donors have emphasized the importance of the policy environment, the availability of support services, research and extension services, and effective and sustainable credit systems.

Attempts have been made to improve the effectiveness of agricultural research at both national and regional levels. However, linkages among various players in the agricultural technology system such as farmers' organizations, extension services agents, researchers and non-governmental organizations (NGOs) were not considered until recently to be a key factor in ensuring farmers' access to new technologies.

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Most farmers in Ghana still produce food by subsistence farming. Their ability to adopt new technologies is constrained by their difficult economic conditions (high poverty levels), as well as their beliefs and culture. They are logically risk averse, and they do not respond to market signals, as do commercial farmers, even when reliable signals are forthcoming. Because of this, all aspects of their production systems and economic behavior must be taken into account when technologies are developed. Location-specific variables must also be considered. Thus, strong linkages are necessary if researchers are to be made aware of farmers' needs.

Literature Review

According to many technology system analysts, leadership from policymakers might not be sufficient to ensure integration of research and technology transfer. Policymakers, farmers, and donors must also exert pressure on the system to achieve that end (Sims and Leonard, 1989; Kaimowitz, 1991). Sims and Leonard (1989) asserted that in the absence of pressure or when "default incentives" exist in the system, researchers pursue their own interests and address issues unlikely to be relevant to the needs of farmers, particularly resource-poor farmers. This can only result in poor integration between research and technology transfer. Kaimowitz (1991) identified specific mechanisms that can be used to exert pressure. Policymakers can clearly define goals for institutions. By setting up joint campaigns and programs, eliminating constraints and gaps, and providing a system of sanctions, they can force institutions to work together. He cites the case of the Masagana 99 rice production program launched by then President Marcos in the Philippines in the early 1970s. The program was both an attempt to reduce political instabilities and a response to the need for large rice imports caused by several crop failures. The program was successful, and 3 years later, the Philippines became self-sufficient because of strong integration of research and technology transfer. Kaimowitz also points to the example of rice in the Dominican Republic. After years of pressure, rice yields more than doubled. Political pressure has often been exerted by authoritarian regimes or when a serious crisis arose (for example, Senegal's cowpea crisis in 1985). It should be noted that such tactics have several shortcomings: results may not be cost-effective, secondary effects may be overlooked, and emphasis may be placed on short-term problems or symptoms rather than on basic causes.

Donor agencies can also exert pressure because they provide an important share of resources. The mechanisms at their disposal include the provision of operating funds for specific activities, substantial individual incentives, and constant monitoring and evaluation. In many cases, for example, the Ghana grain development project (Annor-Frempong, 1988), the Dutch technology project (Engel, 1989), the Philippine farming system development project for Eastern Visayas (Bernardo, 1989), and the coconut project in Tanzania (Lupanga, 1990),

integration improved because donor agencies applied these mechanisms. Monitoring and evaluation, as well as making future funding conditional on the success of on-going activities, have served as powerful ways of exerting pressure on donor projects encountered in case studies. Unfortunately, pressure is not usually sustained once the projects end (Kaimowitz, 1991). Funding of research or technology transfer, participation in decision-making bodies, and protests and unrest can be used as pressure mechanisms by farmers. The Colombian Rice Growers Federation (FEDEARROZ) is a good illustration. It has been successful in defining constraints and seeking solutions by attempting to bring together all the organizations working on rice. Farmer pressure has also been recognized as an important factor in the performance of agricultural technology institutions in Japan, Taiwan, and the Netherlands (Röling, 1989; Sims and Leonard, 1989).

According to Kaimowitz (1991), farmer pressure is stronger when farmers are affluent, politically influential, few in number, educated, and motivated to invest, and when they are already users of research-generated technologies. Unfortunately, case studies have shown that only large commercial farmers fall into this category. In many cases, pressure must be exerted by policy makers.

Technology system analysts believe that, given the current state of systems in many developing countries, farmer pressure must be created in cases where it does not exist. Röling and Seegers (1991) advocated inducing small farmers to apply pressure: they should have some control over research, technology transfer, public organizations in the technology system, and technology budgets.

The private sector can exert pressure through financing and contractual arrangements. Private companies can conduct their own research and thus provide pressure in the form of competition with government research. It is important to note that applying pressure does not necessarily lead to better performance. Managers may resist pressure when they perceive it as interference. Resources, in line with the system's mandate, must be available before pressure can yield positive results.

Agricultural Institutional Linkages in Ghana

Linkages among researchers, technology-transfer agencies, and farmers are far from effective in Ghana. This is due largely to the following factors.

1. Missing functions

In many cases, critical steps for generating and transferring technology are missing. One such step is seed multiplication; program formulation and priority setting are other critical

steps. In some instances, institutions do not have formal processes for formulating their research programs or for setting priorities. As a consequence, researchers do not interact with technology-transfer agencies or farmers and cannot incorporate input from these two groups into the research agenda. The national research program is simply an aggregate of activities defined by individual scientists, activities that may have little or no relation to national development objectives, where they exist, or to farmers' needs.

2. Missing linkages

Most of the research systems in Ghana have significant areas of missing linkages, usually due to bureaucratic and institutional barriers, especially in cases where research and extension are based in different government ministries or are located in organizations with differing legal by-laws. In these cases, effective, continuous cooperation between research and extension is difficult.

3. Idle and ineffective mechanisms

Formal mechanisms for cooperation exist, but they are not being used, or are used so poorly that the intended objectives cannot be achieved. Mechanisms for formulating programs and setting priorities are typical examples. People involved in both research and extension are supposed to meet and formulate research programs together. However, during these meetings, researchers merely present their current results and their plan of activities for the following year. In other cases, research managers never even organized the meetings. There have been cuts in financing for linkages, and many linkage mechanisms, such as annual planning, technology review meetings, or publication of annual reports, no longer function.

4. Duplication of effort

Despite the seriousness of the financial constraints facing research and extension, many activities are duplicated. This occurs mainly in diagnosing farmers' problems, which has become "fashionable", and is a task all organizations involved in the technology-generation and -transfer process believe they must do, regardless of whether or not they have personnel with the necessary skills. Because donors make linkages with partners a condition of their research and extension projects, diagnosing farmers' problems is undertaken by all players involved in technology generation and transfer, and has become something of an end in itself.

5. Fluctuations in the use and performance of linkage mechanisms

Because donor resources are often made available to only one player in the system, linkage mechanisms may be put in place and may achieve a high degree of effectiveness for only a short period, often the duration of a project. As soon as the project is over, performance drops sharply. It improves only when donor resources again become available. Thus, fluctuations in linkages are due to the fact that most linkage mechanisms are related to

donor projects; they are not likely to be financed from core resources because of limited funding.

6. Limited input from farmers in formulating research agendas

In Ghana, only a few formal mechanisms exist to ensure that farmers have an influence on research agendas. This is despite the fact that farmers' participation is generally recognized as one of the key factors for ensuring the success of agricultural technology transfer systems. Farmers' involvement is often limited to on-farm trials; however, there is evidence that involving farmers only in on-farm research does not allow them any real input into the research agenda. Nor does it allow them to become part of the decision-making process. Because of poor linkages between station and on-farm research, research managers often blame poor farmer linkages on the lack of traditional involvement of farmers in decision-making in public institutions, on the ineffective organization of farmers, and on their inability to participate effectively.

7. Research and farmers' organizations

Financial and intellectual efforts have been directed towards making public-sector research and extension in Ghana more responsive to the technology needs of small-scale farmers. Farmer-oriented research methods have underscored the importance of farmer participation in technology development and transfer. They also have increased researchers' awareness of farmers' conditions. Regardless, the institutional changes needed to ensure farmers' inputs in forming agendas and priorities of research and technology transfer agencies have not taken place in many cases. Examples from industrialized countries point to the importance of farmers' organizations in bringing about such institutional changes, primarily through their actions as pressure groups demanding greater accountability and responsiveness from research and extension agencies.

Experience indicates that small-scale, poor framers cannot continue to rely solely on the goodwill of public-sector organizations. Rather, organizations representing these farmers must be strengthened so that they can exert an effective demand for agriculture-related services and become active partners in the process of technological change.

In the past, farmers were encouraged to form cooperatives in order to have access to credit. These cooperatives are more or less community based. They are fragmented and have no regional or national chapters to coordinate their activities in order to exert the necessary pressure on the government or donors so that their concerns are factored into technology development and transfer.

8. Poor coordination between non-governmental organizations (NGOs) and national research organizations

In recent years, NGOs have emerged in Ghana and have become part of the agricultural technology transfer system. They supplement or complement the public extension system in some areas, and they compete with it in others. The relationships of these NGOs with public institutions, especially with research organizations, have not usually been cooperative. At best, NGOs maintain formal contacts with research. In some cases, because they question the relevance of the research agenda being implemented by public organizations, they conduct their own adaptive research.

As a consequence of the characteristics outlined above, the general results of agricultural research in Ghana can be summarized as follows.

1. Lack of relevant technologies produced by research

A significant number of technologies produced by research are rejected by farmers because they are not responsive to farmers' true needs. In Ghana, for example, farmers have adopted less than one-tenth of the crop varieties to which they have been exposed. One reason for this is that researchers tend to focus on yield improvement, while often other factors, such as early maturity and drought resistance, are more important to farmers.

2. Technologies remain on the shelf

Technologies remain on the "research shelf" simply because extension and farmers are unaware of their existence, or cannot use them. Research does not have the mechanisms for transferring technologies to extension, or existing mechanisms do not allow extension services to disseminate the technologies effectively. In some cases, the only channels for dissemination are annual reports (which do not have sufficient information on the technologies) or journal articles (which are generally not accessible to extension agents). In Ghana, because of financial problems, or simply neglect, an annual report might not even be produced regularly.

3. Absence of significant technological improvements in the subsistence sector

Most improvements have occurred in the commercial sector: in coffee, cocoa, rubber, palm oil, coconuts, pineapples, bananas, and cotton, but not in the subsistence sector such as maize, cassava, or other tubers.

An Overview of the Agricultural Sector in Ghana's Economy

Ghana's economy is not industrialized; it is largely based on agriculture. The agricultural sector's contribution toward the gross domestic product (GDP), employment, foreign exchange, and tax revenue in Ghana's economy is depicted in the table below. Note that growth fluctuated from 3.9% in 1999, to 2.1% in 2000 and 4.0% in 2001. Therefore, an average growth rate of 3.3% was recorded for 1999 to 2001.

Table 1. Agricultural growth in Ghana's economy since 1991.

Year	GDP (%)	Employment (%)	Tax revenue (%)	Foreign exchange (%)
1991	43.3	49.3	7.6	50.6
1992	41.4	48.7	9.5	41.3
1993	40.2	48.1	5.4	39.8
1994	40.8	47.5	10.6	40.3
1995	40.6	46.8	8.8	40.5
1996	40.8	44.9	12.2	43.2
1997	40.4	45.7	10.9	41.1
1998	40.5	47.6	12.6	43.1
1999	42.1	49.5	13.1	44.8
2000	43.0	50.5	13.4	45.7
2001	44.7	51.5	13.9	47.5

Agricultural Technology Development and Transfer in Ghana

In Ghana, the agricultural extension services under the Ministry of Food and Agriculture as well as some NGOs are at the forefront of technology transfer and information dissemination to farmers. Two of these NGOs are Sasakawa Global 2000 and the Adventist Relief Agency. The Centre for Biodiversity Utilization and Development (CBUD) is a governmental agency involved in the development/generation and dissemination of appropriate technology for farmers and end-users.

Although Sasakawa Global (SG) 2000 projects are not designed from one blueprint, they have similarities, especially in the technology transfer method employed (dynamic field demonstration programs) and the emphasis on improving food crop production. The crop demonstration priorities and programs vary from region to region within Ghana, are determined by the project, and involve working with national research and extension leaders

and smallholder farmers. In recent years however, two specific crop technologies, quality protein maize and conservation tillage, have been taken up in most SG 2000 regions.

1. Quality protein maize (QPM)

Nearly all maize varieties have significant nutritional shortcomings for humans (and other non-ruminant animals such as swine and poultry) that eat maize-heavy diets. Tryptophan and lysine, two of the amino acids essential for human growth, occur in low concentrations in most maize varieties. Because of the low levels of these amino acids, humans are unable to metabolize all of the protein in the maize they eat.

Four decades ago, scientists at Purdue University of the US found that grains of a few rare maize varieties from the Andean highlands of South America contain sufficient tryptophan and lysine for good nutrition. Known as opaque-2 varieties, they were largely genetic curiosities. Their grains were dull and chalky, they gave poor yields, and they were vulnerable to attach from insects and diseases.

Breeding the genes for high protein quality into maize varieties required by farmers was a painstaking effort that took decades. The International Maize and Wheat Improvement Center (CIMMYT) in Mexico undertook the work. Because protein quality is not visible in the maize kernel, laboratory procedures had to be developed for testing the amino acid content of thousands of samples at each stage of the breeding process. Unfortunately, just when superior varieties were ready for release to farmers, budget cuts led to the suspension of the CIMMYT program, although a few breeders particularly in Brazil, China, and South Africa, continued the work.

Ghana's Crop Research Institute (CRI) played a crucial role in reviving what came to be called quality protein maize, or QPM. Starting in 1990, the SG 2000 country director at the time, Dr. Wayne Haag (a former CIMMYT maize breeder), worked with CRI maize breeders to evaluate advanced QPM experimental varieties from the discontinued CIMMYT program. One experimental variety, which had been improved for resistance to maize streak virus at the International Institute of Tropical Agriculture in Nigeria, was found to produce exceptional yields in multi-location trails in Ghana. RI released a selection of this breed in 1992. It is called Obatanpa, which means "good nursing mother" in the Ashanti dialect. Farmers in Ghana now grow this QPM variety on upwards of 200,000 ha because of its good yield; the better protein quality is a bonus. CRI has since released three QPM hybrids and has shared its QPM genetic materials and expertise with scientists elsewhere in Africa.

What began as a small QPM research effort in Ghana has now spread to a dozen African countries. PM varieties based on Obatanpa have been released for commercial production in Burkina Faso, Mali, Mozambique, and Uganda. Other QPM hybrids have been released in Ghana, Guinea, Ethiopia, Tanzania, and Zimbabwe. QPM varieties and hybrids

will soon be released in Nigeria and Malawi. The Africa-wide "QPM movement" which started in Ghana has shown tremendous promise.

QPM is not produced through genetic engineering. It is not a genetically modified organism (GMO). Rather, it was developed from a rare, but naturally occurring, South American maize type, and has been improved using conventional plant breeding methods. It offers all non-ruminant animals, such as human beings, poultry, and pigs, significant nutritional benefits compared to maize possessing normal proteins.

2. Conservation tillage

Sasakawa Global 2000's work with conservation tillage also started in Ghana nearly a decade ago, and the technology has now spread to most SG 2000 project countries. A recent study by CIMMYT and CRI indicates that some 100,000 ha, involving 45,000 farmers in Ghana are now planted using conservation tillage systems. This work involves an effective partnership between national research and extension programs, a special smallholder development program of Monsanto, and SG 2000. This partnership model has been extended to Mozambique, Ethiopia, Malawi, Nigeria, and Tanzania.

Compared with conventional tillage, which involves turning the soil repeatedly with a hoe or animal-drawn plow or tractor, conservation tillage requires little or no soil disturbances. And it has many other advantages: farmers can sow crops sooner after the first rains, in effect gaining a longer growing season; crops residues left on the ground form a mulch that slows rainwater runoff from the soil surface and reduces erosion; through repeated mulching over time, soil organic matter builds up and water penetration and retention improve; in multiple cropping systems, turnaround times between crops are quicker; labor costs are lower because little or no tillage or weeding is needed; and more land can be cropped without significant added investment – an important benefit for capital-starved small-scale farmers.

Conservation tillage methods promoted by SG 2000 involve spraying herbicides for thorough weed control before planting. The dead weeds dry up and become part of the mulch. Farmers can then plant the crop without mechanical tillage. They open a small hole or thin trench through the mulch, deposit the seed and apply fertilizer (usually phosphorus and a minimum amount to nitrogen), and cover it. The plant residues remain undisturbed after sowing.

Mulch management is perhaps is the most demanding aspect of conservation tillage. Farmers must preserve the mulch by controlling brush fires and preventing livestock from feeding on crop residues. As with conventional tillage, crop rotation plays a very important role in breaking potentially damaging disease and pest cycles.

Over time, conservation tillage can raise soil organic matter content, increase carbon dioxide sequestration, improve soil structure, reduce weed and pest problems (in conjunction with crop rotations), and enhance nutrient mobilization.

Smallholder farmers gain significant labor-related and economic benefits. By eliminating traditional land preparation and much of the need to weed, a farm family can save 20 to 25 person-days of labor per hectare of land. This is especially important for the millions of Ghanaian farmers who do not have draft animal due to endemic livestock diseases such as trypanosomiasis and East Cost fever. For women, conservation tillage can provide a substantial reprieve from the backbreaking drudgery of their traditional tasks of hand hoeing and weeding.

By saving time and reducing labor and drudgery, conservation tillage opens new vistas of income-earning activities for smallholder farmers. Farmers can cultivate more land, even without access to draft animals. When conservation tillage is complemented with rainwater harvesting and storage techniques, the time saved from growing crops can be dedicated to value-adding or high-value activities such as the growing of fruit trees and raising of livestock or poultry, fattening beef animals, producing milk, butter, and cheese, or beekeeping for honey production, as well as grass cutter rearing and snail farming for the local and city markets.

In addition, the laborsaving features of conservation tillage can be especially important in countries where endemic diseases like HIV/AIDS and malaria are crippling farm families.

The main disadvantage or constraint associated with conservation tillage is the need to regularly buy herbicides for controlling weeds.

Processing Programs

For 8 years, the Integrated Technology Transfer Unit (ITTU) in Ghana and the International Institute of Tropical Agriculture (IITA) in Nigeria have collaborated in introducing agro-processing equipment designed for small-scale farmers.

1. Linking industry and agriculture

One aim of the agro-processing program is to strengthen the link between agriculture and light industry, which is weak in many developing countries including Ghana. In Africa, and for that matter Ghana, industrial development tends to be regarded as an area for heavy, capital-intensive industry or large private factories. However, agricultural commodities are the main source of raw materials for major industries. Opportunities exist in these areas for small- and medium-scale agro-processing entrepreneurs, but they first need to increase their

productivity through more-efficient crop production to enhance crop processing with improved equipment and link it with better marking.

2. Continuous evaluation

As part of the process to improve the performance of locally manufactured agro-processing equipment, agricultural extension workers collect feedback from farmers and processors, which the ITTU and IITA analyze and use to modify the designs.

In 2001, a survey was carried out to assess the program in Benin and Ghana. The assessment revealed that equipment designed by ITTU and IITA has been widely used in these two countries since 1994.

The survey also found that, almost all ITTU- and IITA-designed equipment in the field is still in use and functioning, even after several years of use, proving its durability and easy maintenance. It was also found that the cassava grater and multi-crop thresher/thrasher are generally owned by groups of farmers. The cassava-processing equipment reduces processing losses by 54% and saves as much as 7% of the labor required. In contrast, individual entrepreneurs tend to own the wet-type grinders and the palm oil digesters, which can process oilseeds. Demand for oilseed products has encouraged individual entrepreneurs to invest in the machinery.

Post-harvest Losses

One of the main problems facing agriculture and, for that matter, smallholder farmers in Ghana is post-harvest loss. Presently, post-harvest losses stand at 51% of all foodstuffs produced in Ghana. This can be attributed to a lack of agro-processing and storage at the required level.

This is clearly unacceptable. Great efforts must be directed towards this area of activity in the agricultural system in Ghana. This will go a long way to reducing poverty levels of farmers and also making foodstuffs available year round at cheaper costs.

Conclusions

Quality protein maize varieties and conservation tillage have much to offer Ghanaian farmers and farmers in Africa as a whole. These and other productivity-enhancing technologies are to be brought to smallholder farmers through appropriate linkages among researchers, extension agents and other technology transfer agents, farmers and farmers'

organizations, and non-governmental organizations.

The technologies are available, and farmers are eager to adopt them. However, the full benefits of these scientific breakthroughs cannot reach the farmers unless much greater efforts by the national government, local governments, and donor organizations are forthcoming. The major challenges are political and economic, not technical.

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Consequences of Agricultural Technology Transfer on Weaker Sections in India

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Prelude

Before discussing the consequences of agricultural technology transfer on the weaker sections in India, the paper begin with basic conceptual clarities about "who constitute weaker sections or more specifically rural poor in India" and "what are the agricultural technologies transferred, which are affecting either positively or otherwise to these rural poor". Very often rural poor and weaker sections in the rural India are used, as synonyms but there are basic differences among them. Rural poor is a broader term include all social classes that are struggling for their livelihood, while weaker sections indicate (but not used exclusively) towards social groups that belongs to a particular category such as caste, economic class, etc. Looking at the social stratification in India, we shall be using both the terms simultaneously. Further classification of the rural poor and weaker sections is discussed in section one of this paper.

Agriculture in rural India provides direct livelihood to nearly 70 % of the population, either as cultivator or agricultural labourers. Since middle of the last century agriculture was managed on the traditional knowledge system existed and carried over by the farming community through their generations. After independence India faced an acute food shortage due to huge gap between the production level and demand for major foodgrain crops. There were two options available for increasing production of the food grains; first by increasing area under the crops and secondly, by increasing productivity of the major food grain crops. After assessing, the scope for both the strategies it was decided to increase the productivity of the agriculture through introduction of new High Yielding Varieties and through bringing matching change in the package of practices. Since then there has been continuous change in the production techniques of the major crops. This paper looks at the agricultural technologies, which were transferred during green revolution, post green revolution and post economic reform period for assessing their impacts on the rural poor.

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The text in the paper is divided in to four sections; first section discusses the agrarian context for setting target groups on which impact of the agricultural technology transfer is analyzed. The second section analyses the technological changes that have taken place in the decades of 1960s, in post green revolution and in the post economic reform period. The quantitative increase in the agricultural production is analyzed in section two. The third section analyzes the impacts of agriculture technology transfer on qualitative aspects such as agrarian structures, livelihood, sharing of benefits, etc., of rural poor and weaker sections. Fourth section summarizes the lessons, which are learnt from the agricultural technology transfer and suggests the ways for future.

Part I

To locate weaker sections in the agrarian context, let us have a look on the agrarian categories in India. The criteria for agrarian categorization are debated and there emerges two schools of thoughts for differentiating agrarian community; first is based on the agrarian history and second on the economic classes. According to the agrarian history and pattern of land ownership in India, we may have five different classes of the rural community such as landlords, rich farmers, middle peasants, poor peasants and landless agricultural labourers (Oommen, 1989). This categorization is based on the traditional agrarian relations and very often it is difficult to identify the categories. While agrarian categories, which are decided on the acreage of the land holding are widely used. In this paper we shall be assessing the impact of the agricultural technology transfer on the six agrarian classes according to their land holding (Table 1 and Table 2), which are clubbed in to four according to their capability to absorb the agricultural technology transfer. These agrarian classes are described here.

1. Large farmers

This group of farmers is traditionally landlords who own but do not cultivate land. In economic terms any individual who owns 10 hectares and above land comes in this category. According to the 1991 census 1.6 % of the total land holding in India are in this category and this small category controls nearly 17.4 % of the land. Further, large farmers in the scheduled caste communities are less than 1 % and control nearly 2.2 % of the SCs owned land (Table 2). This suggests that Social Group, which comprises of Upper Castes and Backward Castes, controls land in India.

Table 1. Distribution of operational holding and area operated in 1985-6 and 1990-1 all social groups

Category of holding	No. of operational holdings (millions)			Area operated (million/ha.)	
	Units	1985-6	1990-1	1985-6	1990-1
Marginal (below 1 ha.)	No	56.15	62.11	22.04	24.62
	%	57.80	59.00	13.40	14.90
Small (1-2 ha.)	No	17.92	19.96	25.71	28.70
	%	18.50	19.00	15.60	17.30
Semi-Medium (2-4 ha.)	No	13.25	13.91	36.67	38.25
	%	13.60	13.20	22.30	23.20
Medium (4-10 ha.)	No	7.92	7.63	47.14	45.05
	%	8.10	7.20	28.60	27.20
Large (10 ha. & above)	No	1.92	1.67	33.00	28.90
	%	2.00	1.60	20.10	17.40
Total	No	97.16	105.26	164.56	165.62
	%	100.0	100.00	100.00	100.00

Source; Indian Agriculture in Brief, 1995

Table 2. Distribution of holdings by various social groups by categories in 1985-6 and 1990-1

Categories	No. (millions) and percentage of holdings by social categories						
	Units	Scheduled castes		Scheduled tribes		Others	
		1985-6	1990-1	1985-6	1990-1	1985-6	1990-1
Marginal (below 1 ha.)	No.	8.51	9.44	3.16	3.66	44.48	49.00
	%	70.60	71.80	41.30	42.90	57.40	58.60
Small (1-2 ha.)	No.	1.92	2.11	1.80	2.06	14.20	15.79
	%	16.00	16.00	23.50	24.10	18.30	18.90
Semi-Medium (2-4 ha.)	No.	1.07	1.09	1.55	1.68	10.64	11.15
	%	8.90	8.30	20.30	19.70	13.80	13.30
Medium (4-10 ha.)	No.	0.45	0.43	0.94	0.95	6.53	6.25
	%	3.80	3.80	12.20	11.10	8.40	7.50
Large (10 ha. & above)	No.	0.09	0.80	0.21	0.19	1.62	1.40
	%	0.70	0.60	2.70	2.20	2.10	1.70
All categories	No.	12.04	13.15	7.65	8.54	77.47	83.59
	%	100.00	100.00	100.00	100.00	100.00	100.00

Source; Indian Agriculture in Brief, 1995

Large farmers either live in the same village where they own land or may be absentee owners. Their life style is feudal, they do not work and their activities are organized around traditional types of pleasure seeking. Generally speaking this is a shrinking category due to the introduction of agrarian legislations relating to abolition of absentee ownership, intermediaries, ceiling on land holdings and other reforms. Most of the large farmers are drawn from the traditionally privileged castes such as Brahmins and Rajputs.

In post economic reforms period in India, market economy slowly but steadily penetrating in to the farm sector. The large farmers that also include state, own a large chunk of land; they are giving a way to the Corporate farming in India. Apprehensions are expressed that corporate form of cultivation will displace small and marginal farmers as well as landless agricultural labour from agriculture, as most of the farm operations will be mechanized.

2. Semi medium and medium farmers

These two categories of the farmers generally own land but do not cultivate, they work as farm managers and get the work done by labourers. They look upon agriculture as a business and thereby they produce for market and for profit. This category is the product of green revolution and continuing to remain as beneficiaries of the agriculture technology transfer. They constitute about 20 % of the farmers and generally come from land owning peasant castes such as Jats, Ahirs, Reddis, Kammas, Naires, Patidars, etc. Among the SCs, percentage of semi-medium and medium farmers do not exceed 5, which suggests that changes in the farm sector especially transfer of technology is benefiting only small percentage of the farming community, which is constituted by the landowning castes. These two categories are also enjoying as recipient for the state farm subsidies.

Among these middle levels of farmers, there is another category of the agriculturist, which is not primarily based on the size of their land holding, but this is based on the traditional joint family system. The land of father is not subdivided among his sons, rather his sons hold the land at household level and cultivate jointly on it. Since they have many members in the household, they participate in the agricultural operations directly and hire labourers only for certain operations at certain point of time. Most of such families are uneducated but capable of making rational decisions provided they are convinced with the advantages of the new measures and of course they can afford it.

3. Small and marginal farmers;

Those persons who own less than 2 ha of land mainly constitute this category. Majority (approximately 80%) of the Indian farmers belong to this category (Table 1) and they are aware of economic non-viability of their land holdings but still cultivating, since they have no other alternate livelihood. Among the SCs social class, the percentage of small and marginal

farmers is greater (Table 2).

Often their landholdings are so small that they cannot make both ends meet exclusively through the income derived from it and therefore are also partly laborers. They may also work as sharecroppers or tenants of various types. These peasants find it difficult to secure the benefits available through state either because of their land holdings are uneconomical or because they lack social skills to manipulate the administrators. This category is drawn from almost all caste groups, although most of them may be from backward and scheduled caste.

4. Landless agricultural laborers

This category do not own land, if they did it is not more than abadi land on which their huts are built. Their sole source of income is their labour and hence they are dependent for their livelihood on others; especially on the first two categories of the farmers whose land holding are considerably large. Majority of these labourers belong to Scheduled Caste who occupy the lowest ritual status in the traditional caste hierarchy of India.

From the above discussion, it emerges that traditional society in rural India may be put under four broad categories; first two may be said as well to do categories while later two qualify to be labeled as weaker sections. Theoretically, our emphasis should be to analyze the impacts of agricultural technology transfer on the lower rung in the chain of the agrarian hierarchy that is landless agricultural labourers but evidences suggests that there are drastic changes in the traditional agrarian relations (Tyagi *et.al.* 2002, Chandy and Tyagi 1998). Labour market has developed in the areas, which have contributed maximum to the foodgrain production in India. These labour markets help the landless labourers in rural areas to shift their occupation between farm and non-farm activities according to the availability of work. Therefore, it would be difficult to assess the impact of agricultural technology transfer on the socio-economic activities of landless labourers. On the other hand marginal and small farmers are sticking to the agriculture for their livelihood either as cultivators or agricultural labourers. Thus, weaker sections for this paper will include marginal and small farmers along with landless agricultural labourers.

Part II

This section attempts to analyze the technological changes and their impacts on the Indian agriculture during last fifty years. India remains one of the few countries, which has witnessed significant changes in the agricultural technologies and equally spectacular changes in the life and living of rural population. Technological advancement in the farm sector of certain areas such as Punjab, Western Uttar Pradesh, Haryana, etc., brought widespread changes in society and economy of these states. The agricultural technologies that led to significant consequences are biological, chemical and mechanical in nature.

Though increase in farm productivity has always been sought in India's development programmes through diffusion of biological, chemical and mechanical innovations, spectacular results in certain states were obtained only as a result of green revolution in the decade of 1960s to 1980s. The success of green revolution is highly dependent on the use of high yielding dwarf varieties, chemical fertilizers, and pesticides, along with assured irrigation. This led to the rapid expansion of the irrigation facilities through tube wells, canals and other means.

Green revolution proved a turning point in the modernization of Indian agriculture. It boosted intensive use of land resources, enhanced utilization of available water resources, changed cropping pattern, increased input, etc. The contribution of technological invasion in Indian agricultural can also be seen in diversification of the economy to non-agricultural areas. With increase in the farm productivity, there has been a corresponding spurt in activities connected with secondary and tertiary sectors of the economy. Over the year dependency of population on agriculture has decreased from 75 to 68 %. There is continuously shift of the people from agriculture to non-agriculture areas.

Indian's food grain production increased four fold in a span of fifty years, but this increase could remain limited to the few crops and few areas (Table 3 and 4). The unique example of the wheat in Punjab, Haryana and Uttar Pradesh could not be universalized. The national average for wheat productivity increased from 668 kilograms per ha in 1950-51 to 2,708 kilograms per ha in 2000-2001, which is an increase of 400 %. On the other hand productivity for pulses could register an increase of 23 % only over the period of 50 years, which may not be considered as significant change from any perspectives (Table 3). Similarly, agricultural technology transfer could not make significant change in the production and productivity of oilseeds and course grains. Here it is significant to be considered that oilseeds, pulses, course grains and even 60 % under rice is rainfed, even then growth performance of oilseeds and pulses is far below the satisfaction and it is waiting for technological breakthrough as in case of wheat.

Another phenomenon began from green revolution and followed thereafter till now is regionalization of the agricultural development to the certain states, which are performing better. For example in year 2000-2001, 43.79 % of foodgrain production in India contributed by Uttar Pradesh, Punjab and Madhya Pradesh, while in the same year Uttar Pradesh, Punjab and Haryana jointed contributed 68.19 % of the total wheat production (Table 4). This encouraging performance of some states can be attributed to the spread of new technology pertaining to the crop cultivation. These evidences suggest that regional imbalance caused by green revolution in the decades of 1970s and 1980s has been further widened in the decade of 1990s. The consequences of the regional imbalance and other outcome of the agricultural technology transfer are discussed in the next section.

Table 3. Production (million tones) and productivity (kilograms/ha) of major crops and oilseeds in India since 1950-2000

Crops	Production/ Productivity	Time Series					
		1950-51	1960-61	1970-71	1980-81	1990-91	2000-01
Rice	Production	20.58	34.58	42.22	53.63	74.29	87.70
	Productivity	668	1013	1123	1336	1740	1961
Wheat	Production	6.46	11.00	23.83	36.31	55.14	69.68
	Productivity	663	851	1307	1630	2281	2708
Course cereals	Production	15.38	23.74	30.55	29.02	32.70	31.08
	Productivity	408	528	665	695	900	1027
Pulses	Production	8.41	12.70	11.82	10.63	14.26	11.08
	Productivity	441	539	524	473	578	544
Total food grains	Production	50.83	82.02	108.42	129.59	176.39	199.54
	Productivity	522	710	872	1023	1380	1648
Oilseeds	Production	5.16	6.98	9.63	9.37	18.61	18.44
	Productivity	481	507	579	532	771	810

Table 4. Leading states in production of food crops and oilseeds crops 1999-2000

Crops	States	Production	% share to all India	Cumulative % of production
Rice	West Bengal	13.95	15.59	15.59
	Uttar Pradesh	12.91	14.43	30.02
	Andhra Pradesh	10.49	11.72	41.74
Wheat	Uttar Pradesh	25.98	34.38	34.38
	Punjab	15.91	21.05	55.43
	Haryana	9.64	12.76	68.19
Total coarse cereals	Maharashtra	6.45	21.16	21.16
	Karnataka	5.25	17.22	38.39
	Uttar Pradesh	3.75	12.30	50.69
Total pulses	Madhya Pradesh	3.80	28.46	28.46
	Uttar Pradesh	2.60	19.48	47.94
	Maharashtra	2.19	16.40	64.34
Total foodgrains	Uttar Pradesh	45.24	21.66	21.66
	Punjab	25.20	12.06	33.72
	Madhya Pradesh	21.02	10.06	43.79
Total oilseeds	Madhya Pradesh	5.59	26.78	26.78
	Rajasthan	3.58	17.15	43.94
	Maharashtra	2.64	12.65	56.59

Part III

The new technology for its quick spread was instrumental in bringing about significant changes in whole development policy and strategy of India. From very beginning India's development policy was influenced by the ideals of rapid economic growth with social justice. Community Development programme was launched in 1952 to bring about all round development of rural communities. However in view of the increasing food shortages and mounting concern for immediate gain in production led to the shift in developmental priorities. Consequently agriculture was given top priority in the rural development and efforts were concentrated since early sixties in selected areas with high production potentials. Such a strategy was translated in to action through a series of programmes such IADP (Intensive Agricultural District Programme), IAAP (Intensive agricultural Areas Programme), etc. The change in the strategy is accompanied by drastic change in the developmental organization, agricultural administration, research and extension system, credit and input supply infra-structure, storage and marketing facilities, transport and communication network, etc (Kalcon, 1970). This technological upsurge has given rise to three types of problems; extension of green revolution to rainfed areas, second creating additional facilities for storage and problem of equity, welfare and employment.

The requirement of controlled and assured irrigation has also acted as constraint in restricting the effects of green revolution to a limited area. The land with assured irrigation facilities and higher fertility levels offered greatest promise to raise agricultural production through seed-fertilizer technology. The bulk of India's food grains production as also marketable surplus come from irrigated agriculture. The choice logically fell in favour of northern Indian states such as Punjab, Haryana and Western Uttar Pradesh, forming continuous irrigated tract, which is known as the main seat of green revolution and is providing 90 % of the wheat and 75 % of the rice for public distribution system (Bhatia, 1988). The rainfed areas comprising 70 % of the land as against 30 % of irrigated areas remain outside the fold of green revolution.

Yet another constraint in the spread of green revolution was the concentration of development efforts among farmers in such areas where favorable infrastructure facilities like credit institutions already existed. The allocation of inputs was also determined on the basis of resource endowment, past performance and eligibility criteria. The provision of scarce modern inputs mainly for those who can make their optimum use rather than thinly spreading them provides a rationale for this approach. This approach contributed in restricting the benefits of green revolution to certain areas and groups.

Since beginning of green revolution, the new technologies in agriculture are increasing the dependence of the farmers on external sources for supply of the agro-inputs. Farmers are increasingly becoming dependent on the market for new seeds, chemical fertilizers, plant protection measures, farm machines, etc. Agricultural has become increasingly capital intensive since dependence on purchased inputs has substantially increased. This has also implied increased dependence of agriculture on external and international markets particularly for chemical fertilizers, pesticides and oil for running irrigations pump sets, tractors and other machinery (Dasgupta, 1983). With interventions of the transnational corporations in the agro-input supply business such as hybrid seeds, etc., have brought the farmers on the cross roads and they are not able to decide wheather tp remain abstain from the technology or adopt it. This process has gradually drawn marginal and small farmers away from the benefits of the technology transfer. Since late 1990s, cases of suicide by the farmers in green revolution areas vindicate the hypothesis that agriculture Technology Transfer has benefited the well-off farmers in well-off areas. Increasingly dependence of the farmers on the market is proving detrimental to the marginal and small farmers, who can not afford to buy costly seeds and fertilizers or at-all if they buy, it bring them in the trap of financial crisis, which compel the farmers to take steps like suicide.

It is evident from the discussion above that introduction of new agricultural technologies have resulted in further increase in the disparities. It is mainly because of weakening position of the small and poor farmers that there is gradual reinforcement of the powers to the rural rich. The distribution of assets, particularly that of landed one, is highly skewed. The inheritance laws and resultant fragmentation of holding is further worsening the condition of poor farmers. In contrast, the power of the larger farmers by adopting new technology has further strengthened and their profits and assets have increased substantially. New acquired farm assets such as tractors, tube wells are getting concentrated in to the hands of rich farmers resulting in to a new kind of patron-client relationship between the rich and the poor farmers. New economic policies of the Indian Government initiated in the beginning 1990s have further alienated the small and poor farmers from the benefits of the new technologies in agriculture.

The argument put forward in the decade of 70s of the last century that new technology has generated additional work opportunities in the farm sector do not hold true. The multiple cropping and intensive agricultural made it necessary to mechanize certain operations which in turn displaced both human and animal power to a certain degree. Though there are some work opportunities generated by new technology in the tasks such as fertilizer application, weeding, interculture operation, harvesting and post harvest operations but it does not compensate for displacement of the landless agricultural labourers caused by mechanization of the farm operations.

Greater consequences of the new technologies are observed on the traditional agrarian relations, institutional frameworks and agrarian structures, as a result of undue emphasis placed on the technological solution to the food problem and due to negligence of the institutional issues involved in it. The new technology was tilted in favour of areas and groups endowed with better quality lands, assured irrigation, facilities, more developed infrastructure and better resources. It was assumed that in due course, benefits of the new technology would percolate down to the poorer regions and groups. Conversely, the increase in the food output and employment as a result of new technology will bring additional income to all sections of the population including poor and landless. The rationale underlying the strategy was that the scarce resources and modern input should reach first to those areas and people who are likely to make their optimum use. This selective approach is opposite to the objectives of community development programme, which aimed to benefit the whole community.

The prospects of double cropping and increased chances of additional benefits led a steep rise in the rents, resumption of land for self-cultivation, eviction of tenants and dispensing with hired labour. The landlords prefer contract or casual labour. The crop sharing arrangements have also undergone change; the landowner now do not agree to give land on crop share basis since the same amount of grain given to the share cropper now fetches much higher amount of money. Payment is hence made now in cash rather than in kind. These changes have affected the landless agricultural labourers and marginal and small farmers who were engaged in the sharecropping arrangements.

Further, the concentration of efforts and rapid increase in productivity mainly in irrigated and well-endowed areas and regions is responsible for two inter-related consequences. First, it has accelerated the process of economic polarization, and secondly, it has promoted social tensions and antagonism between different agrarian classes. Widespread violence in the state of Punjab for more than a decade after the region was covered by green revolution is a live example of the social tension. The Punjab, which was more or less an average state at the time of independence, emerged as most prosperous state after green revolution, thereby causing regional imbalance. The villages in Punjab are well equipped with basic infrastructure facilities such as brick built houses, developed roads, electricity, schools and hospitals, etc and present altogether a different picture. Rural Punjab presents a striking contrast to the poverty stricken, dark counterpart elsewhere with muddy roads and mud walled thatched roofed houses and few social amenities. One can witness similar contrast between villages and groups with in a region, which also manifest great disparities in productivity and incomes depending upon their access to productive resources and new technology. The growing economic disparities combined with increasing un-employment and exploitation of tenants, sharecroppers and landless labourers tended to increase social tensions among different

classes. Bihar, which lies in the eastern part of India, is facing social tension between two communities namely Bhumihars (land owning classes) and landless labourers mainly Scheduled Castes, which were share croppers on the land of Bhumihars once upon a time and now asking for their rights on the land as well as other common properties in the village domain. Yet another source of mounting tension is the increasing influx of migrant from poorer regions to the green revolution areas in search of livelihood. It is in these in built contradictions of the new technology, it is increasingly being feared that areas of green revolution may turn into the grounds for bloodshed due to social tensions.

It is evident from the discussion on the consequences of the agricultural technology transfer that the new technology, with its dependence on the modern inputs and progressive farmers for its success, is able to provide enough food but not employment to the poor. Evidently distribution aspect seems to be neglected and not working at all. The costly nature of inputs like tractors and tube-wells continues to make the new technologies biased against small farmers. The insufficient institutional credit as compared to the total cost of inputs, inaccessibility to the credit institutions, complex bureaucratic formalities, rigid lending procedure, and similar factors making it almost impossible for poor villagers to get financial support. The obvious inference one can draw in such situations is that the gains of new technologies are reaped more by already prosperous regions and groups thereby accentuating further regional imbalance and economic inequalities between the rich and the poor.

Part IV

If the Agricultural Technology Transfer is allowed to go on as it is today, majority of the small and marginal farmers along with landless labourers shall be displaced from the agriculture and there is likely to be migration by masses towards cities. If slogans such as the transformation of rural life, or the achievement of growth with social justice are to be translated into reality, then new technology should be made affordable to the small and marginal farmers. In the post economic reform period there are clear evidences that state is gradually reducing subsidies from agriculture, so we cannot expect the state to subsidies the technologies. In this situation answer has to be searched by the farming community themselves with in their own resources. These conditions necessitate for changes in social organization of the agrarian relations. The marginal and small farmers shall have to organize themselves in to the groups either as cooperatives or any other form of interest groups, which could take up farming on economy of scales.

There are striking examples within Indian state of the economic benefits that can accrue to the small cultivators by collective actions in the groups. The Bhartiya Agro Industries Foundation in Pune, Maharashtra has sponsored a whole set of co-operative activities like lift

irrigation, dairying, poultry, and joint farming based on the concept of uplifting the rural poor through the latest agricultural and animal husbandry technique. The work of the Kaira District Cooperative Milk Producers' Union, Anand, is too well known and need no description. The Tudiyalur Cooperative Society has been providing total service to about 8,000 cultivators in Coimbatore district of Tamilnadu. The Syndicate Agriculture Foundation Manipal, Mahatma Gandhi Lift Irrigation Co-operative Society Gaddipalli, Kerala Development Society, etc., are few more example of the cooperative initiatives.

The future of farming lies in the group initiatives and there is need to universalize the isolated success stories cited in the previous paragraph through multiplications and replications. At the village level this can be done by the combination between those who possess the technical knowledge and those who are devoted to social service and together identify and prioritise the needs of the villagers. If the needs are correctly identified, prioritised and properly attended, it will act as catalyst for the marginal and small farmers. Let me end up with a quotation of Dr M. S. Swaminathan.

"India's political freedom depends on rapid economic growth and this in turn depends on its performance in agriculture. The future of India's agriculture in turn depends on the success with which the educated can help the small and illiterate farmers to take the many small steps, which alone can lead to a great agriculture. Science can only show the way; it is for us the educated and privileged class, to provide the will".

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Utilize Farmers' Organizations for Agricultural Technology Transfer and Training in Japan

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Introduction

1) Some approaches for agricultural technology transfer and education for farmers in Japan have been implemented by central and local governments and farmers' organizations, which are generally organized as agricultural cooperatives (Japan Agricultural Cooperatives or JAs). This paper focuses on agricultural cooperatives and their ways of transferring technology and education, i.e., farm guidance.

2) In recent years, we have faced such problems as a decreasing overall number of farmers, and increasing numbers of aging farmers and part-time farmers, who have agricultural and non-agricultural incomes. The roles of farm guidance carried out by agricultural cooperatives of Japan will attract more attention for improving economic activities and management of agricultural cooperatives from now on.

3) However, conventional methods of farm guidance, which employ production and management guidance targeted at individual farmers and commodity-wide groups and which are voluntarily organized by farmers by specific commodities, are not adequate for current and futures conditions. They also have difficulties meeting the expectations of farmers in situations of diversifying management scales and styles and changing production, marketing, and distribution systems for agricultural produce.

4) Farm management has been diversifying, which requires more individually oriented approaches to guidance rather than a group-oriented approach. Furthermore, more-enthusiastic and studious farmers, mostly full-time farmers and corporations established by farmers, are more aware of the self-responsibility of management and are willing to take more-active roles in acquiring new management techniques and high-level farming technologies.

5) Under these circumstances, farmers are increasingly demanding that farm advisors change their usual guidance approaches of "teaching farmers", "giving directions or instructions to farmers", or "letting them do it" in a unilateral manner to approaches utilizing "consultation", "advice", "support", and "discussion and study together".

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Agricultural Cooperatives in Japan

1) Agricultural cooperatives of Japan, called JAs, are organized in all municipalities and involve almost all farmers in Japan as regular members under the *Agricultural Cooperative Society Law* enacted in 1947.

2) Features of the agricultural cooperatives of Japan are distinct because of they are of a so-called "multi-purpose" type which conducts various kinds of businesses. The businesses that the agricultural cooperative can conduct are stipulated in the said law as follows:

JA-mandated activities under the *Agricultural Cooperative Society Law*

Education and public relations, and guidance on farming and lifestyle issues

They provide educational programs for improving agricultural technology and operations, enhancing living standards, and promoting cultural activities.

Activities related to agricultural production

They develop and improve farmland, organize joint use of irrigation facilities and joint farming work, and install facilities to improve labor efficiency.

Entrusted farm operations

They operate farmland entrusted by members.

Farmland trust

They oversee farmland trust holdings.

Marketing

They market, store, and transport agricultural products.

Purchasing

They supply production materials and essential goods.

Credit

They loan funds for agricultural production and living expenses, and accept deposits.

Insurance

They provide mutual life, fire, automobile, and building endowment insurance.

Utilization

They establish agricultural production and residential facilities for joint utilization.

Processing

They process agricultural products.

Public welfare

They establish hospitals and clinics.

Senior citizens' welfare

They establish facilities and programs to care for senior citizens.

Residential land administration

They transfer and purchase farmland entrusted for residential development.

Among these activities, education and public relations, guidance on farming and lifestyle issues, and activities related to agricultural production are closely related to technical guidance and education for effectively transferring technology to farmers; so we can equally call them members of the cooperatives.

3) Guidance and education in technology and farm management is considered to fall within the field called "farm guidance" and this plays important roles not only in technical and farm management aspects, but also in the all aspects of cooperative activities.

4) Integrated approaches of multi-purpose cooperatives

   (1) Through credit, marketing, supply, and utilization, services were undertaken by our society; but even in pre-war days, it was not called a multi-purpose cooperative society. In those days, the four services mentioned above operated independently, and there was little linkage among them. Each of these four services, however, is an integral part of a farmer's economic life. It was necessary, therefore, for agricultural cooperatives to contribute more effectively to increasing agricultural production and improving economic and social standards of farmers by integrating various functions through farm guidance services.

   (2) Each business activity of agricultural cooperatives only partially covers the socioeconomic needs of members, while the guidance services of agricultural cooperatives for farm management and improving life deal with improving members' agricultural production and family life in their totality. Guidance services consist of identification of members' needs, planning, formulation of implementation programs, study of improved techniques, and the organization of members for joint projects.

   (3) When we discuss marketing, purchasing, and credit business, we always focus on commodities handlers, operating funds, and business efficiency. This may lead cooperatives to treat members not as owners but as customers. Guidance services always emphasize how to secure a happy and quality life for farm family members. Integrating different services through the medium of guidance services is the focal point, therefore, for multi-purpose agricultural cooperatives, so that each business program is well oriented to needs at the grass-roots' level.

   (4) The basis of integration is the attainment of target incomes and home-life improvements of individual farm management plans, which are formulated with the help of farm advisors and advisors on improving the quality of life from the

cooperatives. Then, business programs of each cooperative are drawn up on the basis of the needs identified as assessed in the process of each individual planning unit.

There are several ways of integrating various activities in order to increase agricultural production and farm income.

By farm guidance

-Formulating farm management schemes;
-Improving infrastructure and land conditions;
-Studying and introducing production techniques; and
-Studying and introducing management techniques.

By commodity-wide groups

-Working jointly with other member farmers.

By credit business

-Procuring funds (as loans) required for implementing farm management plans.

By purchasing business

-Procuring farm inputs

By farm guidance

-Producing a product

By utilization of facilities

-Harvesting crops.

By utilization of business/marketing business

-Collecting, grading, processing, packaging, and marketing (by joint shipment and marketing).

By credit business

-Settling the marketing proceeds (as savings).

Significance of Farm Guidance by Agricultural Cooperatives

1) The 3-year campaign to strengthen agricultural cooperatives and farm guidance begun in 1956

(1) The 3-Year campaign to strengthen management of agricultural cooperatives and farm guidance.

a) The central union of agricultural cooperatives (JA Zenchu), as the apex organization of agricultural cooperatives in Japan, established "the Outline of

Farm Guidance Activities of Agricultural Cooperatives and the Implementation System" in October 1956. This stated that the farm guidance of agricultural cooperatives should be implemented to improve farm household economies and business activities of agricultural cooperatives.

b) The functions of agricultural cooperatives are basically to improve farmers' economies, and farm guidance should form the basis for business activities and lead to well-planned and integrated farm management practices.

(2) Objectives of the establishment of a farm guidance system

a) Farm guidance should be the basis of integrated business activities of agricultural cooperatives.

b) The system of farm guidance should collaborate with agricultural extension services of the government, and farm guidance at the municipal level should be conducted by primary cooperatives. Guidance is comprised of two factors: one internal to the cooperative, i.e., general business planning of the cooperative, and the other external to the cooperative, i.e., guidance for acquisition of technology.

2) New recognition of farm guidance for renewing activities of agricultural cooperatives: the current situation

(1) JA farm advisors provide farm households with guidance in agricultural techniques, farm management, and the selling of agricultural produce. Activities of farm advisors range widely from introducing new crops and high technologies to surveying trends of shipping markets and buyers, to providing guidance in farming. Farm advisors, called the "face of JA", play an important role as intermediaries between JAs and farm households.

(2) In the revised *Agricultural Cooperatives Law* which went into effect in June 2001, the primary purpose of JAs was changed from providing credit to farm guidance. Thus, the importance of farm guidance of JA is clearly stated in the law. The 22nd National Congress of Agricultural Cooperatives passed a resolution which contained the following purposes: a) to guide agricultural production by JA's sales strategies and reinforced sales forces; b) to identify and promote people who can shoulder the responsibility for regional agriculture in the future; and c) to provide farm guidance for executing JA's agricultural strategies in individual regions. In line with the resolution, JA groups engage in holding various activities like seminars, preparing manuals, etc., in order to provide production and marketing planners with

high levels of skills and knowledge in the fields of farm guidance, marketing, and planning for the future.

Development of the farm guidance business and changes in the main tasks

Year	Economic situation	Main tasks of farm guidance	No. of farm advisors
1947~1954	Lack of food production	Technical guidance for increasing production	4240
1955~1959	Attainment of food self-sufficiency	Strengthening guidance for farm management	10,369
1960~1979	Increase in the demand for livestock and agricultural products	Integrated guidance from production to marketing	14,828
1980~to the present	Appearance of gaps in the demand for agricultural products, expansion of import liberalization, and trends of increasing numbers of farming women and aging farmers	Reduction in mid-term agricultural promotion of production costs	17,704

Farm Guidance

1) The role of farm guidance

Farm guidance is directed at the overall management of agricultural activities on members' farms, with the intention of creating the required desire for and momentum to establish rational farming management systems, and of perpetuating such farming management practices throughout the areas involved, so as to make members of the cooperatives aware of their potential to work in partnership to achieve their aims. The role of farm guidance is seen as establishing organizations in which these activities can be implemented on a partnership basis.

As such, farm guidance is not something that is applied on an individual basis to member farmers, but is rather something that makes up policy within each region's local agricultural development plan, and which also plays a role in land reform, organizations considering land and machinery use, organization of facilities, and sales plans, as well as other aspects related to the organization of regional farm management.

Farm guidance should also be based not only on overall economic operations, but also with the aim of improving management for farmers, so as to play a more-effective role.

2) Main thrusts of farm guidance

To provide farmer-members of agricultural cooperatives with proper guidance and direction towards effective farm management by:

(1) Disseminating information on the introduction of new farming techniques and improvements in management of farm operations by such means as training, workshop, seminars, conferences, etc.;
(2) Formulating agricultural promotion plans in keeping with local and national government programs;
(3) Identifying potential production areas by selecting and cultivating crops by considering market trends and demands;
(4) Demonstrating effective utilization of available resources and providing advice on promoting diversified farming;
(5) Introducing sustainable growing techniques and practices of organic farming, etc.;
(6) Promoting joint purchases of farm inputs; and
(7) Developing a consciousness of environmental concerns, preservation, and protection.

3) To promote the independent behavior of farmer-members by:

(1) Forming commodity-wise groups;
(2) Promoting the training of staff;
(3) Training the leaders of commodity groups, youth, and women; and
(4) Identifying and coordinating potential market outlets.

Scope of Activities

1) The scope of agricultural cooperatives' farm guidance is extremely wide, covering everything from individual farming management practices to local agricultural cooperatives' overall operations. Much thought has been given to where to place the focus of training and organization within that scope.

2) The ultimate target of farm management is to improve incomes and profitability of farms. The first issue that has to be addressed in order to achieve this is to determine land conditions, since they are so closely related to production methods. Land surveys, irrigation, drainage, soil dressing, deep tilling, plot organization, exchange of land, etc.

need to be organized at a group level. Agricultural cooperatives themselves also must take up the challenge of organizing land for agricultural use, improving and managing the land, creating and managing irrigation facilities, etc.

3) The second target is to create a system that allows the efficient use of agricultural land. In order to achieve this, the cooperative is required to play a central role, and bring together owners and tenants of agricultural land in an area, in order to increase the availability of land for agricultural use.

4) If there is no person available within the member's family to work a plot, then the agricultural cooperative can be commissioned by the relevant member to work the plot either as arable land or as pasture, and the cooperative then leases the plot in question to another member. (Some agricultural cooperatives implement land commissioning).

5) The cooperatives are also required to install large-scale equipment, which can then be commissioned for use by their members. Cooperatives are also responsible for managing and working on any projects commissioned by the members.

6) Through undertaking commissions for farm management, the agricultural cooperatives assist the development of local group production organization. They also facilitate the employment of farming and other specialists, through undertaking commissions to farm members' land (wet rice, etc.).

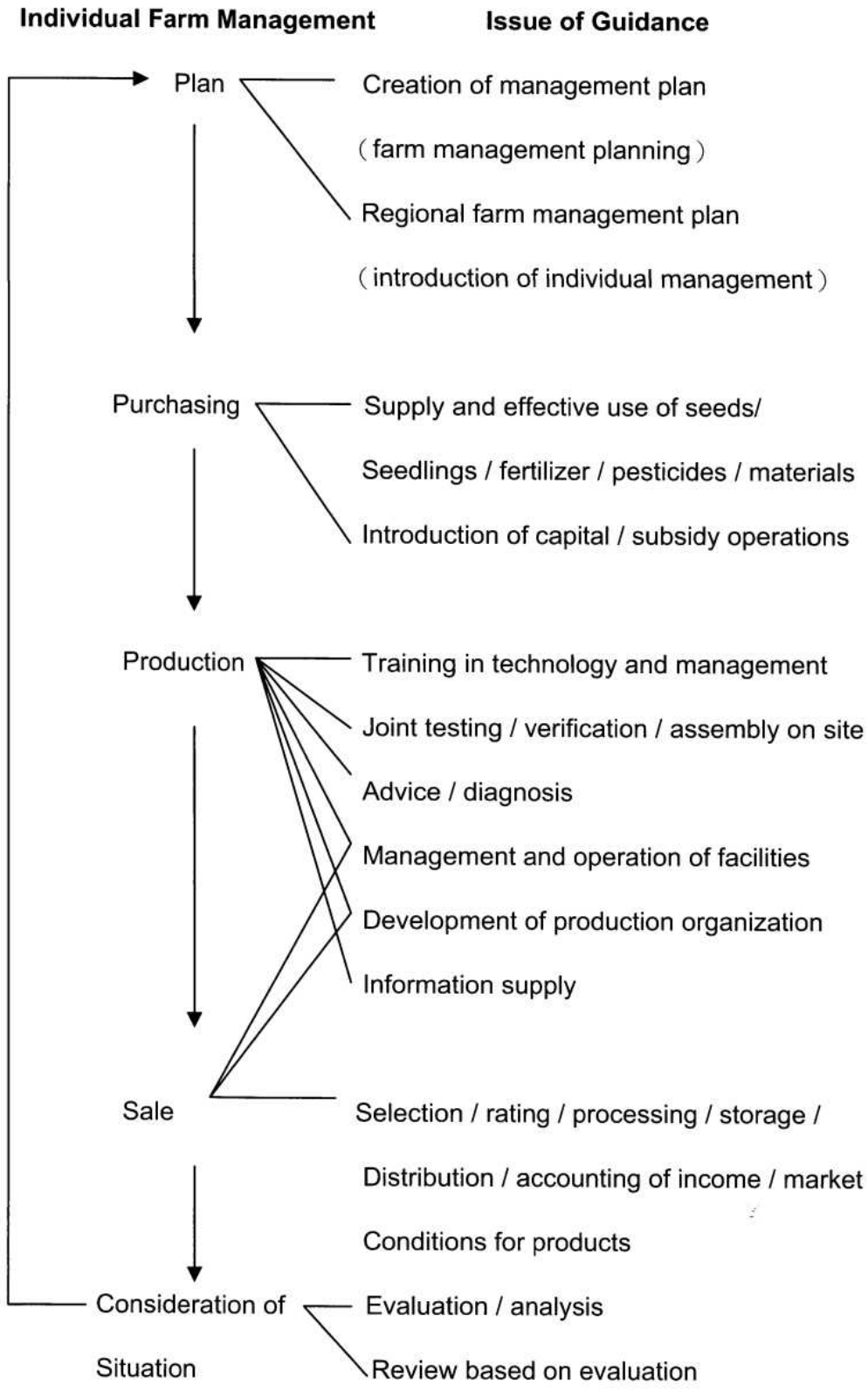
7) Agricultural cooperatives also need to play a more-proactive role as a holding and rationalization foundation for agricultural land, by renting land from members, and then leasing that land to other members who wish to expand the amount of land they are using. This will facilitate the rationalization of agricultural land use.

8) In addition, cooperatives can also offer recommendations for seeking or accepting work commissions, as well as manpower, by working together.

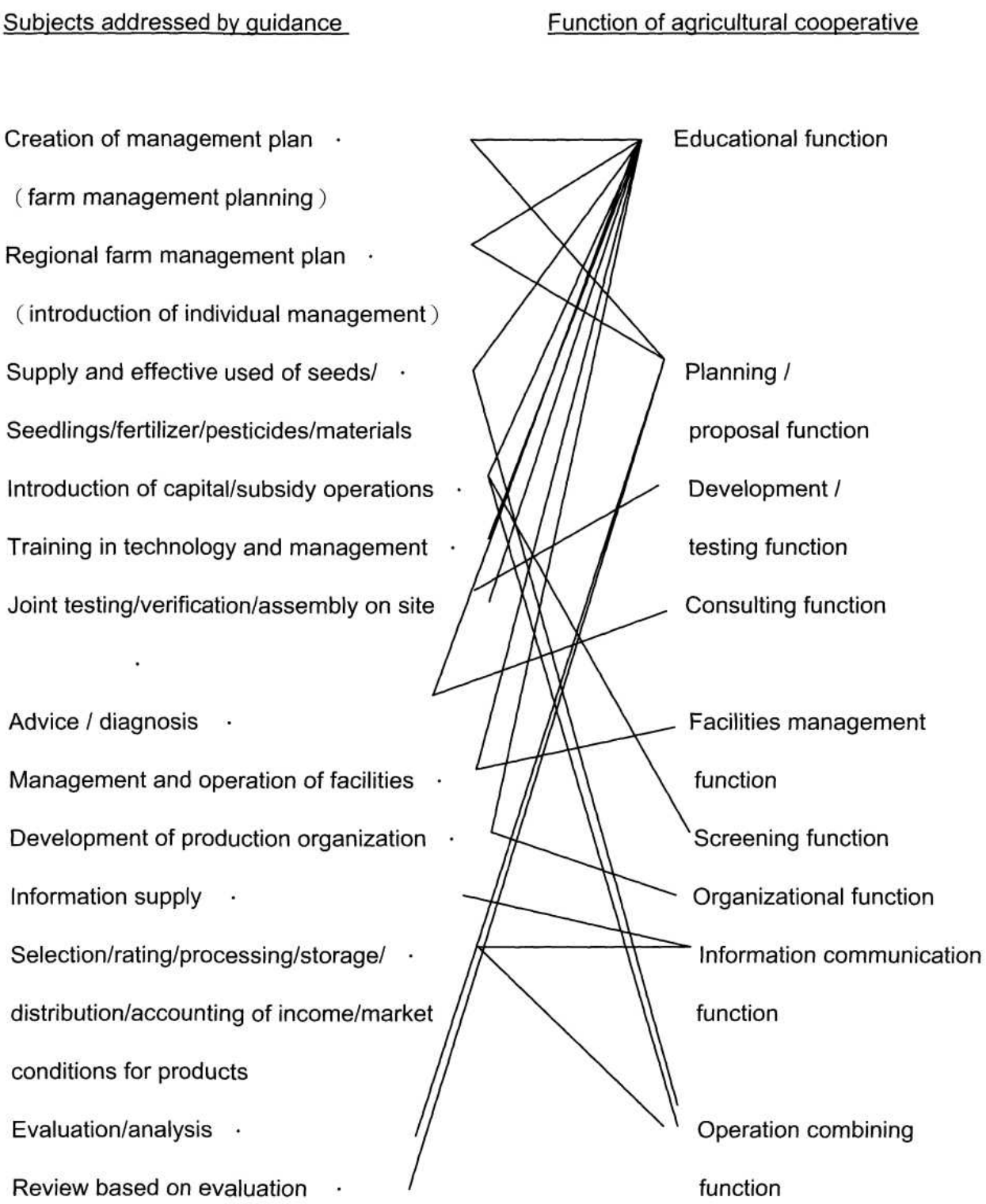
The scope of activities can also be summarized as follows:

-Planning of farm management in accordance with the regional Agricultural Promotion Plan;
-Improvement of farm infrastructure;
-Quality control and joint marketing of farm products and joint purchase of farm inputs;
-Promotion of group farming by commodities;
-Exchange of cultivation and breeding techniques; and
-Close collaboration with agricultural extension offices and other relevant institutions.

Individual Farm Management and Issue of Guidance


Individual Farm Management
Issue of Guidance
Plan
Creation of management plan
(farm management planning)
Regional farm management plan
(introduction of individual management)
Purchasing
Supply and effective use of seeds/
Seedlings / fertilizer / pesticides / materials
Introduction of capital / subsidy operations
Production
Training in technology and management
Joint testing / verification / assembly on site
Advice / diagnosis
Management and operation of facilities
Development of production organization
Information supply
Sale
Selection / rating / processing / storage /
Distribution / accounting of income / market
Conditions for products
Consideration of Situation
Evaluation / analysis
Review based on evaluation

Subject of Guidance and Agricultural Cooperatives



Farm management activities in primary cooperatives and federations at a prefectural level

Stage of farm management	Function of the primary cooperative	Function of the federation
1. Farm planning	>Formulation of the agricultural promotion plan	>Projection of future agricultural situations >Promotion of guiding technology in relation to the agricultural promotion plan
2. Information dissemination about production technology (introduction and practice)	>Dissemination/circulation of technical Information >Consultation to promote new/special technologies >Systematization and technical training	>Development of technology >Systematization and technical training, education, and consultation about special technologies
3. Management Improvement	>Guidance in the selection of crops >Improvements in farming methods (individual and group)	>Revenue and expenditure analyses according to the kind of commodity >Production of farm planning materials >Assistance/training on bookkeeping and record keeping
4. Effective management of land, labor forces, and funds	>Protection and adjustment of the use of agricultural land >Ensuring success of promotion activities	>Technical guidance on the promotion of joint production groups according to the commodity
5. Joint production activities	>Installation of management systems for joint production and the promotion of commodity groups >Selection of group leaders	>Technical guidance on joint production groups according to the commodity
6. Gathering of information (market and agricultural information)	>Dissemination of information to members	>Collection and screening of information >Dissemination to primary cooperatives
7. Complimentary marketing system (warehousing/storage consignment, and stabilization)	>Warehousing/storage of farm products >Identification/creation of market price stability measures Promotion/advertisement of marketing business	>Promotion of price stability measures >Schedule of collection
8. Assessment/evaluation	>Identification of strengths and weaknesses of the farm guidance system including farming problems >Assessment of farm conditions >Evaluation of supply and demand >Promotion/advertising >Review/evaluation of individual farm plans	>Assessment of farming conditions >Evaluation of supply and demand >Promotion/advertising >Assessment of rural agricultural plans
9. Re-planning	>Improvement of individual farm plans >Improvement of management systems	>Improvement of agricultural plans >Improvement of marketing plans

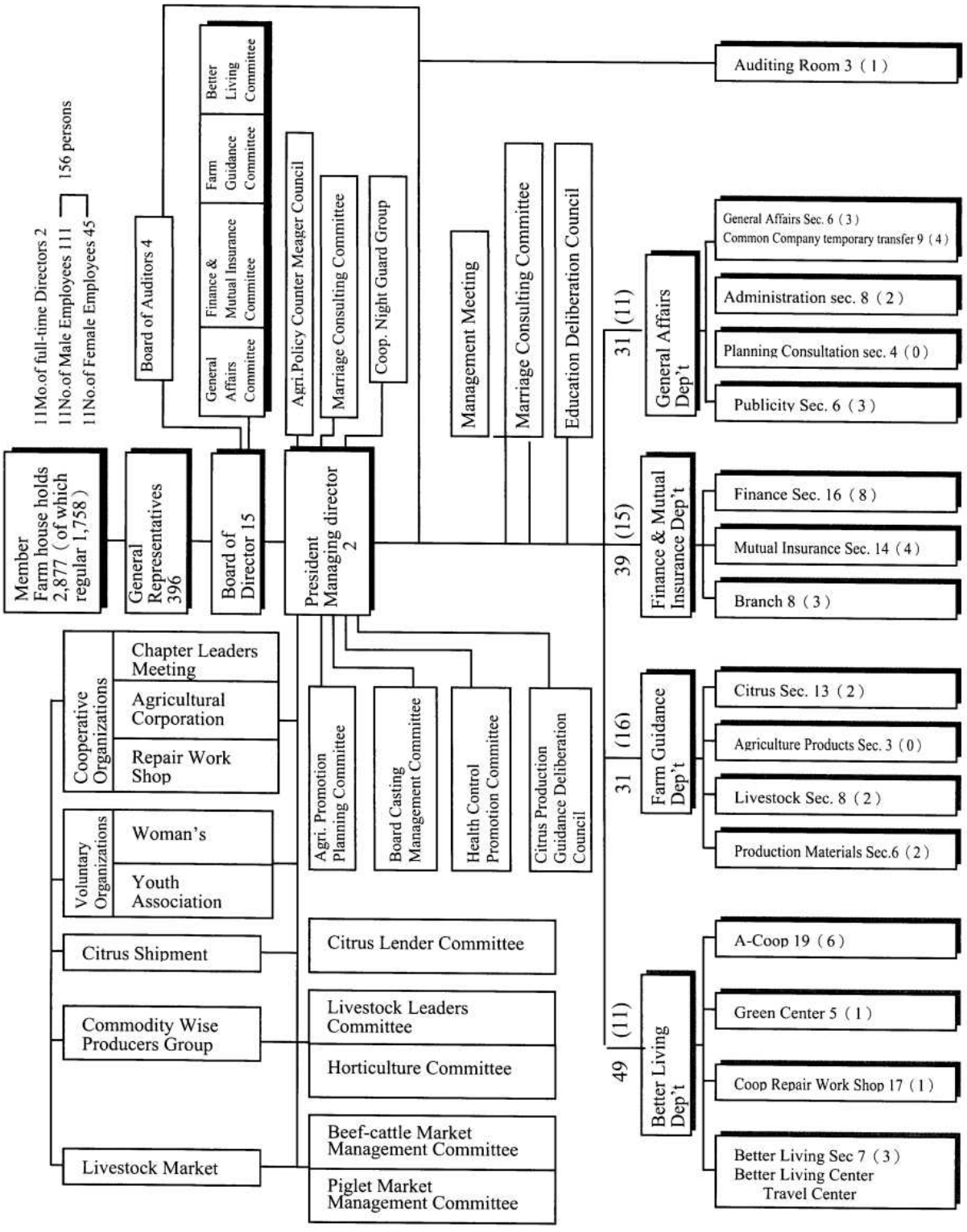
Common Features of Farm Guidance Methods

1) Meetings, discussions, lectures, contests, etc.
2) Printed materials, leaflets, newsletter, posters, and magazines.
3) Actual business operations and special events like exhibitions, contests, and examinations.
4) On-the-spot guidance, joint work, inspections, and bookkeeping.
5) Broadcasting media.
6) Interviews and home visits.
7) Research findings on production technologies, use of market information policies, and programs related to agricultural development.
8) Promotion of difference organizations, i.e., organizations of producers, women, youth, and the elderly, and other rural organizations.

Promoting Farm Advisors

1) Methods for establishing a farm guidance business structure
   Consolidation of the internal structure of Agricultural Cooperatives (JAs)
   (1) Strengthening awareness of the president and full-time officials of JAs.
   (2) Securing business expenses.
   (3) Securing farm guidance advisors.
      a. Recruitment of advisors from outside the JA.
      b. Assignment of JA staff in charge of the marketing and purchasing business to the farm guidance section.
   (4) Establishing cooperation systems among staff in charge of marketing, purchasing, and credit businesses.
2) Recruitment and compensation arrangements.
   (1) Nomination of a cooperative staff member who possesses qualifications of a farm adviser. He/She must be physically and mentally fit, possess high integrity, and an excellent work attitude.
   (2) Hiring of a retired employee from an agricultural university, extension office, or research institution.
   (3) Making use of outstanding farmers who possess special knowledge and skills.
   (4) When the cooperative is not financially capable, the federation to which it is affiliated can initially pay for the services of the farm adviser.

Case-Position of farm guidance department at JA Mikkabi (Mikkabi-cho Agricultural Cooperative)



Case study on farm management and technical guidance system supported by cooperative organizations at prefecture

< Case 1 > in Nagano Prefecture

1) The prefectural union of agricultural cooperatives established qualification system for farm advisor, which makes the position of farm advisor clear in the cooperative organization. In addition to the qualification for farm advisor, the other qualifications such as subject matter specialists, management consultant, consultant for livestock farming are prepared for specialization and improvement of skills.
2) Staffs in charge of farm guidance are appropriately assigned through primary cooperatives and the prefectural economic federation.
3) The roles of the prefectural union and the prefectural economic federation are clear. The union is in charge of planning and the federation in charge of implementation.
4) Uniform commodity-wise groups at a prefectural level (special committees = advisory committee for the economic federation are organized to realize farm guidance to be linked with marketing business.
5) Organization for farm advisors at a prefectural level is organized, called farm management group of JA officials and employees), for training purpose to support farm advisors.

< Case 2 > in Aichi Prefecture

1) Training program for farm advisors

   The prefectural union offering basic training program is collaborating with the prefectural economic federation offering specialized training program. Especially the economic federation has gained strong support from the prefectural experiment station. (e.g. 100-day training program by crop).

2) General farm management and technical guidance for horticultural products (flowers and vegetables)

   (1) The function was taken over by the prefectural economic federation from the prefectural horticultural federation in 1978 and strengthened to handle purchase of production materials, marketing of agricultural products and farm guidance.

   (2) In 1992, farm management support center as the horticultural federation's version of technical extension center was established under the control of general farm management office of the prefectural economic federation for experiments of newly developed technology and varieties (collaboration and share of function with the

prefectural agricultural experiment station). Furthermore, it has the function of education and training of producers by accepting farm successors as assistant research staff.

3) Measures for up-grading quality and capacity of farm guidance advisors

(1) Strengthening of training by unions and federations.
(2) Dispatch of personnel's to the national, prefectural research institutions or universities for study over the long period.
(3) Long-term training at advanced agricultural cooperative.
(4) Exchange meeting with farm guidance advisors in the neighboring JAs.

4) National federation of agricultural cooperatives (called JA Zen-noh)

(1) The national federation for marketing and purchasing businesses also offers the training programs to farm advisors of primary cooperatives.

(2) Agricultural R&D center is a comprehensive technical center, and its major activities include the following.

a. Maintenance of JA farm support center functions
b. Tests and research & development
c. Technical training courses
d. Inspections
e. Reception of visitors and trainees
f. Information collection and distribution

(3) Details on farm supporting and agricultural machinery & facilities sections

a. Farm supporting section

-Planning and research relevant to the promotion of JA R&D center functions.
-The section participates in model JA inspection projects and supports detailed policy-making for the promotion of functions based on local conditions so as to determine how JA can serve as a local agricultural center.
-Development of know-how and methods relevant to farming business consultations and to regional farm planning.
-Promotes the spread of new technologies for labor conservation, labor reduction, cost reduction, etc.
-Issues publications such as professional journals, provides means of business diagnosis for farmers, and corporate in regional farm planning.
-Conducts surveys and provides information for the promotion and spread of environmental conservation in agriculture.

-Working together with the fertilizer and pesticides sections, the materials section, and the machinery & facilities section, this Section takes part in efforts to reduce the costs of production materials.

b. Agricultural machinery & facilities section

In order to achieve low-cost agricultural production and reduce costs uniformly throughout form production to distribution, this Section engages in the following activities.

Confirmation and testing of new products and new technologies

-Before dealing in new agricultural machinery products, spot items are investigated primarily in terms of new functions and mechanism. Structure, quality, special features and other characteristics arc determined and the products are evaluated for purchase. Confirmation tests are also performed as necessary depending on the products characteristics.

-On-site performance tests are conducted on plants and technologies at newly developed agricultural facilities. Consultations are held with manufacturers concerning results and information is provided to the agricultural co-operatives where plants and technologies are scheduled to be introduced.

Investigation, research and development activities

-Through cooperation with other research sections and manufactures, this section engages in R&D on new operational technologies associated with production materials. It also conducts research to accumulate date as required for the basic design of plants at agricultural facilities. In addition to investigation and research of items pertaining to purchasing duties, the section engages in testing on consignment and in joint research with universities and testing centers covering more specialized topics.

Education and training

-This section provides education and training to various personnel; for example to those in charge of agricultural facilities or agricultural machinery at JA or prefectural economic federations various types of education and training are offered, including initial training in farm machinery basics to those newly assigned to be in charge of such machinery, as well as operator training, all for the purpose of acquiring knowledge and practical skills.

< Case 3>

Training program designed for farm guidance at a primary cooperative basic training plan for FY 2001

Training name	Purpose	Subject	Contents of training
Farm advisor training	Training for qualification of farm advisors and training of qualified farm advisors	Persons in charge of service windows of JA branches and persons newly employed by JA	Introduction to crops (paddy rice, wheat, soybeans); introduction to soil and fertilizer; introduction to disease and insect pest; introduction to horticulture (vegetables, flowers, fruits) 8 days (4 days x 2)
Basic training in farm management	Providing basic technical knowledge	Persons in charge of service windows	Identification of real things and practical field training 4 days (2 days x 2) Basic techniques to cultivate crops (paddy rice, wheat, soybeans); basic horticultural techniques (vegetables, flowers, fruits); measures to control various types of disease and insect pest 8 days (4 days x 2)
Training for strengthening farm guidance	Providing basic and technical training and on-the-job training to full-time farm advisors of JA's key branches	Qualified farm advisors of JA's key branches	Basic training in cultivation of crops (paddy rice, wheat, soybeans); basic training in horticulture (vegetables, flowers, fruits); on-the-job training in fertilization of soil and control of disease and insect pest 40 days (20 days x 2)
Specialized training	Providing advanced farming technology and problem-solving training to full-time farm advisors of JA's district business offices and head offices	Qualified farm advisors of JA's district centers and head offices	Basic technology for cultivation of crops (paddy rice, wheat, soybeans); basic horticulture technology (vegetables, flowers, fruits); fertilization of soil and control of disease and insect pest 10 days of on-the-job training
Field training of farm advisors at individual JA district centers for solving problems in specific regions			7 persons; 100 days a year

Support Organizations

1) In order to effectively and efficiently carry out said activities; it is incumbent on a coop to forge close and coordinated working relationship with various organizations.

>Agricultural Development Organizations

>Support organizations:

-Local government units (Pref. gov't, municipality offices)

-Research and experiment institutions

-Extension offices

-Agricultural Colleges and Universities

-NGOs

-Cooperative development council

-Irrigation and drainage utilization association

-Crop insurance office

-Others

2) Functions:
   (1) Policy formulation and advocacy
   (2) Receipt and analysis of reports
   (3) Adjustment and improvement of policies and activities
   (4) Monitor the implementation
   (5) Assess/evaluate/plans and implementation

Agricultural Extension Service by Government

1) In Japan, the extension service started in 1948 as the most fundamental promotion measure of nation's agriculture policy. Since then, setting up extension centers in which extension advisors are allocated, it has been supporting farmers who try to increase their technical and managerial abilities through its educational approach.

2) Characteristics of the extension service in Japan

The extension service in Japan has been implemented based on the Agricultural Improvement Promotion Law (No. 165 of 1948.) with the following characteristic features:

(1) The cooperative work performed by the national and prefectural governments.

(2) The collaboration with a research institute in smoothly developing, and then extending technique which meets needs of farmers or communities.

a) The service which targets people by taking a direct approach to farmers for giving them technical and managerial instruction.

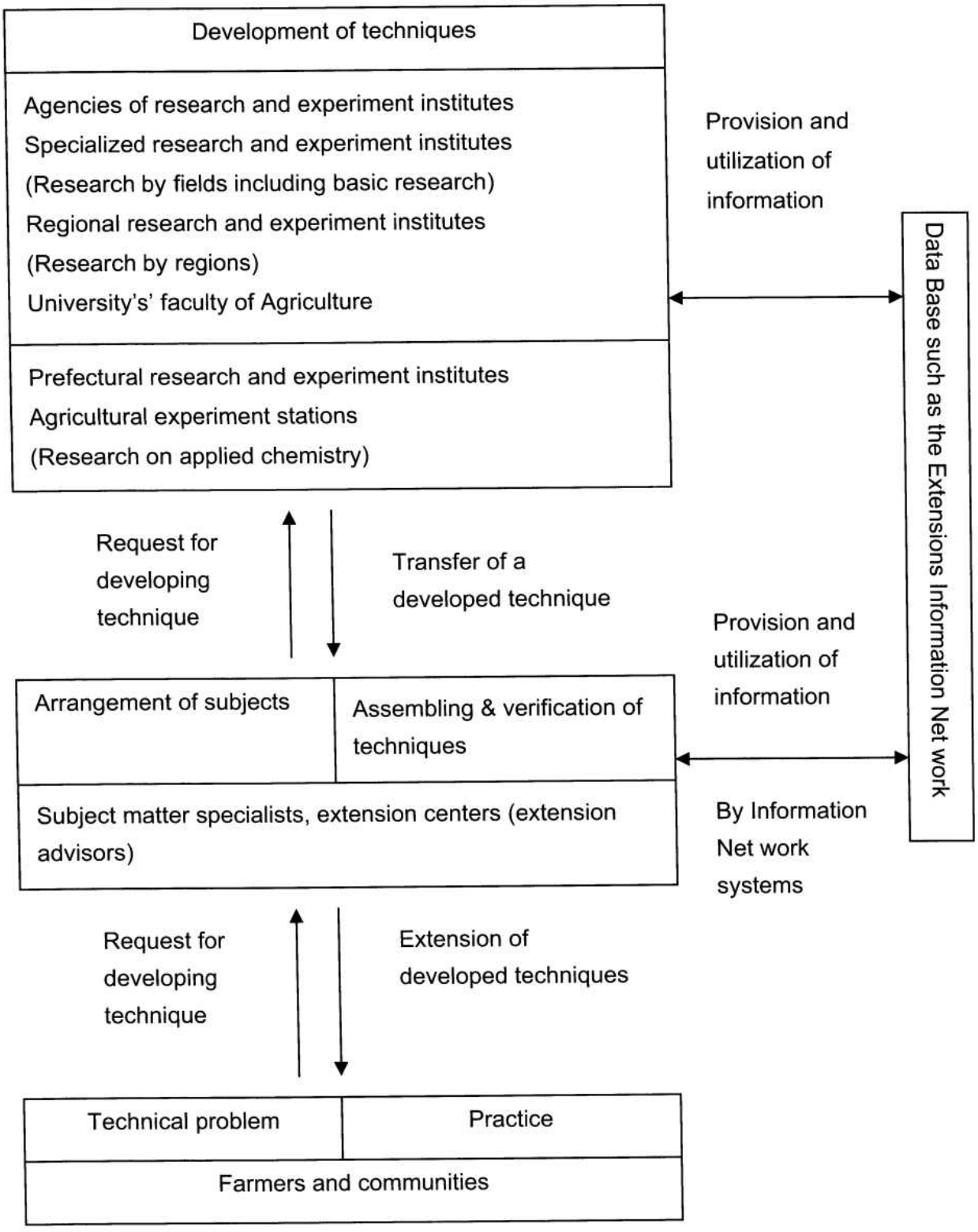
b) The integrated activity for the improvement of farming and daily life.

3) The cooperative work performed by national and prefectural governments

The extension service has been contributing to smoothly transferring farming techniques, which results in the rise of a farmer's level as a whole. That consequently gives the significance to the national government which is responsible for the stable supply of food, and also to prefectural governments which responsible for the promotion of agriculture and rural communities by making best use of local resources.

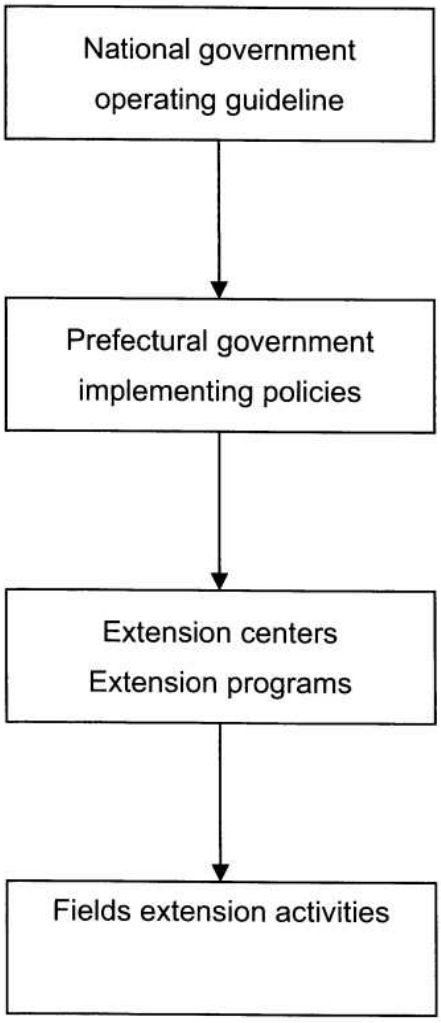
4) It is also important to exchange knowledge or techniques among prefectures so as to nationally increase the productivity and the ratio of self-sufficing food. In this respect, the cooperative work is the efficient system in which the national government first formulates such basic policies as the allocation of extension advisors, and then building the consensus of the national government, a prefectural government actually carries out the extension service.

5) In practice, the Agricultural Improvement Promotion Law defines the extension service as the cooperative work promoted by both national and prefectural governments.


Development of techniques
Agencies of research and experiment institutes
Specialized research and experiment institutes
(Research by fields including basic research)
Regional research and experiment institutes
(Research by regions)
University's' faculty of Agriculture
Prefectural research and experiment institutes
Agricultural experiment stations
(Research on applied chemistry)
Provision and utilization of information
Data Base such as the Extensions Information Net work
Request for developing technique
Transfer of a developed technique
Arrangement of subjects
Assembling & verification of techniques
Subject matter specialists, extension centers (extension advisors)
Provision and utilization of information
By Information Net work systems
Request for developing technique
Extension of developed techniques
Technical problem
Practice
Farmers and communities

Flowchart of the development and extension of agriculture techniques in Japan

The execution of the extension service – accordance with the basic policies which are determined after the discussion between the national and a prefectural government:

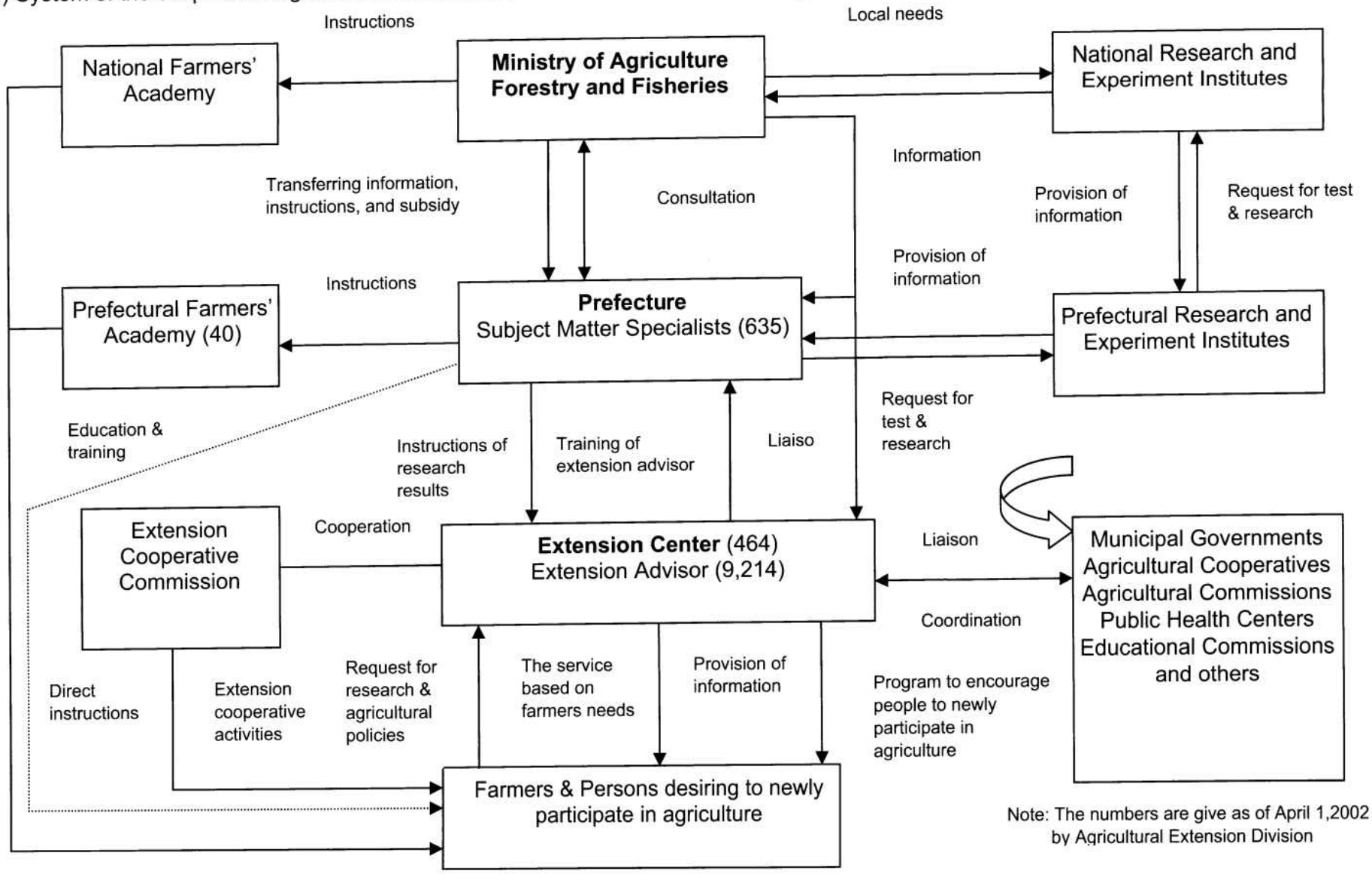


Formulated by hearing the opinions of a prefectural government.

Formulated based on the operating guidelines in consultation with the national government.

Formulated based on the implementing policies.

6) System of the cooperative agricultural extension service and coordination with agricultural cooperatives



Note: The numbers are give as of April 1,2002 by Agricultural Extension Division

Farmer's Training and Educational Institute (Farmer's academy)

1) Being defined as a part of the extension service, farmer's academy is founded in respective prefectures. There, it has been educating and training those who are interested in newly participating in agriculture, in addition to the children of farm households. Particularly, its programs emphasize on advanced agricultural and managerial techniques by which they will improve their farming business.

2) The academy has three departments as follows:

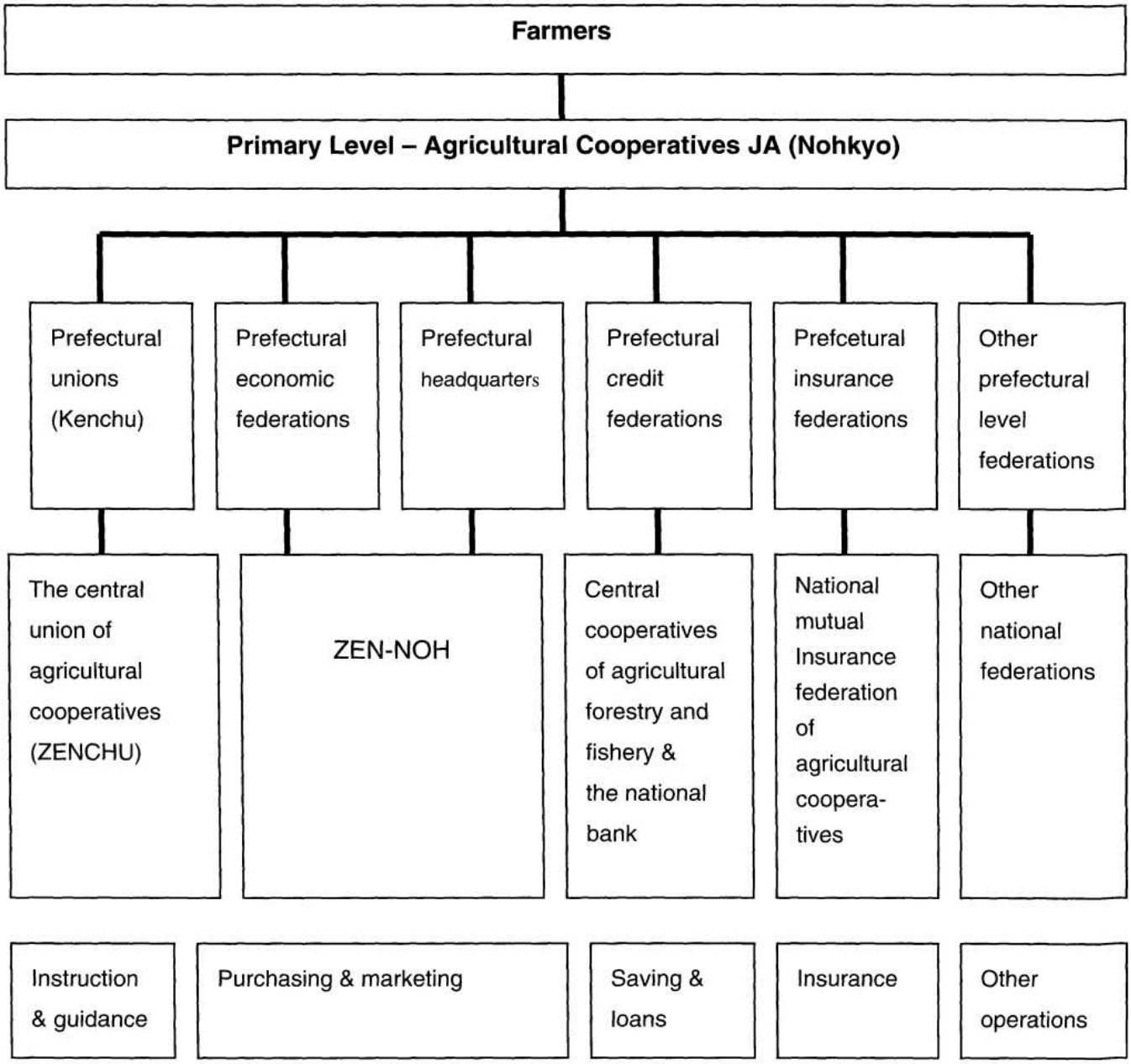
   (1) Fostering department in which high school graduates take two-year practical training with all of them living in dormitories;
   (2) Training department: in which short-term training is particularly given to those who will come back their home town to start farming; and
   (3) Research department: in which graduates of receive one-to-two year advanced training.

Guidelines of opening farmer's academy

Opening	In compliance with regulations		
Name	Proper name for the purpose, for example xxxx prefecture farmer's academy		
Principal	Proper person for the position, for example a person who has not only a profound insight into youth education, but also wide knowledge about agriculture and a rural community.		
Capacity	In compliance with regulations or rules by taking into account of the climate of agriculture.		
Departments	Fostering department (Long-term training)	Research department (Advanced training incl. farm management)	Training department (Short-term training according to student's farm management)
(Qualification)	High-school graduated or those who have similar scholarly ability to them	Graduates of junior college or the fostering department	A governor of respective prefectures will decide candidates and capacity.
(Terms)	Two years in principle	1 or 2 year(s) provided by regulations	Within one year
(Hours)	More than 2,400 hrs, or 80 units in 2 years	More than 1,200 hrs or 40 units per an annum	

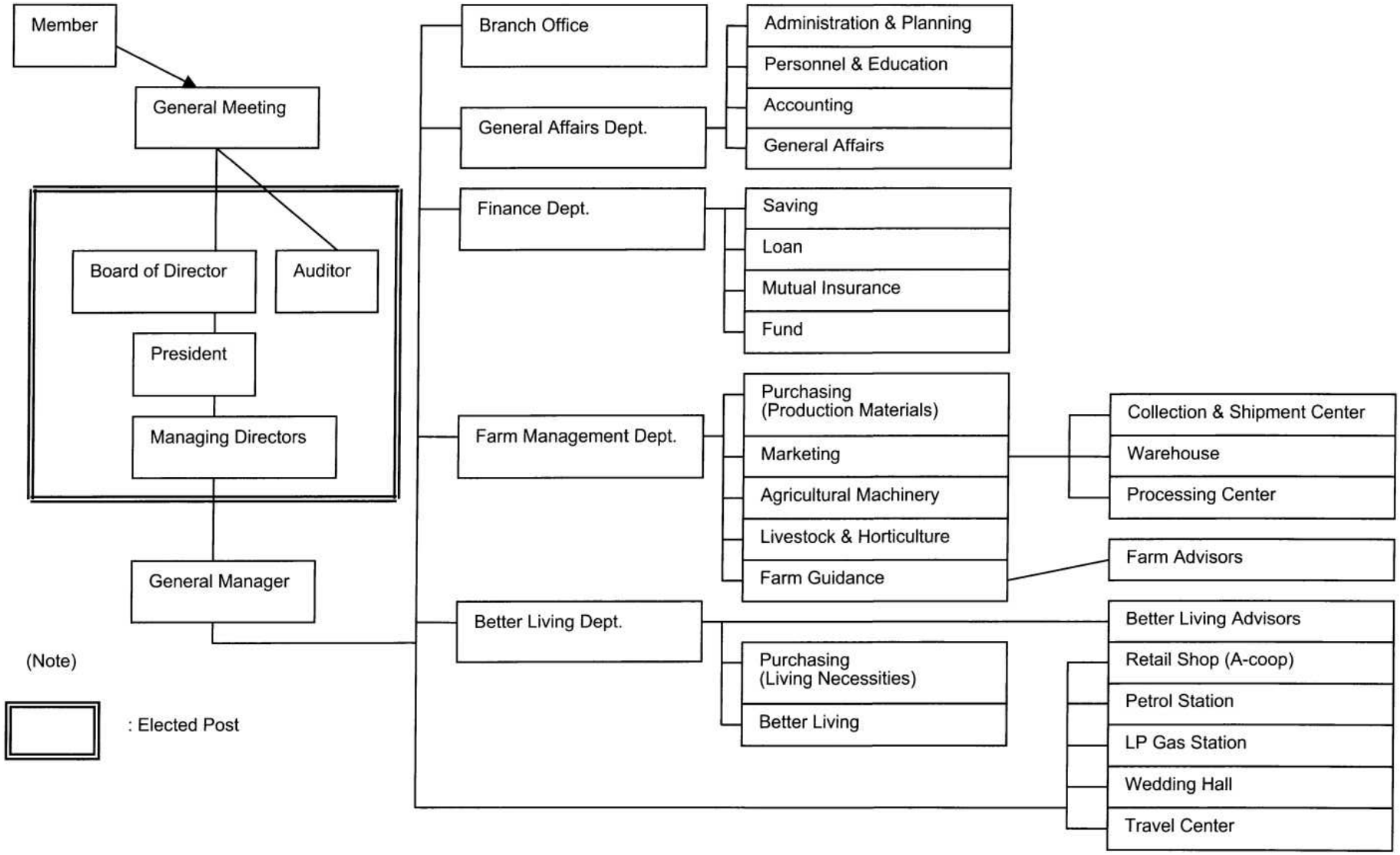
Attachment–1

Agricultural Cooperative Organizations (JA Group)



Attachment–2

General Pattern of Internal Structure of Multi-purpose Agricultural Cooperatives



Attachment–3

Members' organizations in agricultural cooperatives

1. Members' organizations relating to management of JA
   (1) Representative members
   (2) Chapter leaders
   (3) Officials and auditors
   (4) Hamlet level discussion meeting
2. Members' organizations relating to agricultural production and marketing activities
   (1) Commodities-wise group and joint marketing of JA
   (2) Various joint utilization group
      a. Grading center operation group
      b. Country elevator
      c. Joint nursery of seedlings – business of JA
      d. Joint use of farm machinery
         -JA lease out machinery to members
         -Farm machinery operators group
   (3) Hamlet farm management group
   (4) Joint shipment association
   (5) Morning market group (direct sale of farm products)
   (6) Green tourism group
   (7) Joint processing group
   (8) Kitchen garden group to curtail family expenses to be spent for vegetables
3. Members' organizations relating to purchasing business of JA
   (1) Joint purchasing group for daily necessities
   (2) Joint purchasing group for home delivery of food ingredient
   (3) A-Coop friendship group
   (4) Agricultural affairs association and advance order for farm input

Attachment–4

Cooperative farm guidance activities and governmental extension services and their relevance to the development of agriculture & agricultural coops in Japan

1. Introduction
2. Trends in agricultural & agricultural coops in Japan

1) Agriculture
   - Progress of aging of farmer
   - Lack of farm successor
   - Low self-sufficiency of food
   - Increased Import of agricultural products due to liberalization policy
   - Shift in Agricultural policy from producer oriented one to consumer-oriented (Lessor government assistance and independence is being much called for.)

2) Agricultural cooperatives
   - Amalgamation of agricultural crops has been promoted 10,000 coops in 1960 to 950 in 2003 Goal is 500.
   - Reform of agricultural cooperative is in rapid progress
   - Characteristics of Japans agricultural coops;
     Multi-purpose (economic, guidance, credit, insurance and etc.,
     Concept; from cradle to graveyard services
   - Women empowerment (increase of female board of director)

3. Agricultural extension by the government & farm guidance by agricultural cooperative for technology transfer.

1) What are farm guidance activities?
2) What's difference between extension and farm guidance.
3) Introduction of farm guidance concept to other Asian countries such as Thailand, Philippines & etc.

Our Institute/IDACA conduct a project and feasibility study to introduce multi-purpose agricultural coops in developing countries with dispatch of experts and acceptance of trainees.

4. Lessons which can be learned from Japans experiences

1) Technical innovation by extension office & agricultural experiment stations.
2) Existence of closer linkages among rural development institutions concerned such as extension office, experiment station, municipal and provincial office, agricultural cooperative, irrigation office and private companies engaged in manufacturing inputs.
3) Existence of strong and integrated agricultural coops.
4) Government assistance for agricultural development such as provision of credit, infrastructure and etc.
5) Establishment of effective market mechanism based upon the traditional peoples mentality which attaches importance to group harmony, consensus or team work rather than individual approach.

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Agricultural Extension Programs in Korea

Yeong-Cheol Cho[1]

Introduction

Agriculture has been an important industry for the Korean people and has been a way of life for, approximately, 5,000 years ago. Korea has natural scenic beauty with mountains, hills, and paddy fields. It experiences four distinct seasons in a year: a pleasantly warm spring, a hot summer, a pleasingly cool autumn, and a cold winter.

However, Korean climatic conditions are generally not very favorable for farming due to the extreme temperatures, uneven rainfall, infertile topsoil, and a lack of arable land. About 65% of the land is mountainous, and 20% of the total area (1.86×10^6 ha) is cultivated for farming. Of the arable land, 1.14×10^6 ha is paddy fields. The remaining 0.72×10^6 ha are uplands.

An average farm household occupies 1.45 ha of arable land as shown in Table 1.

While the total population has expanded with a moderate increase rate, farm population has declined since the 1960s due to rapid industrialization and urbanization. The number of farm households declined from 2.483 million in 1970 to 1.28 million in 2002. The farming population stood at 3.591 million people in 2002, or about 7.5% of the total population of 47.640 million.

As the economy grows and becomes industrialized, non-farm sectors have pulled much labor from the farm sector, and the trend of labor shortages and the price of farm labor have both dramatically increased. Agriculture in Korea still plays an important role in the national economy, although it accounts for only 4.0% of the GNP; however, the importance cannot simply be explained in statistical terms because of multifaceted functions of agriculture in the total welfare of the nation including its contributions to the environment.

During the recent period of economic development, agriculture greatly contributed to achieving rapid economic growth by providing cheap foodstuffs, a diligent workforce, and capital accumulation. The basic standard of living in terms of material affluence has substantially risen due to increased production. However, in spite of the merits of industrialization, it has been a mixed blessing, producing both products and pollution at the same time.

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Table 1. Cultivated area, farm population, number of farm households, average size of land holdings, and average size of farm families (1960~2002)

Year	Cultivated area (10^3 ha)	Farm population (10^3 people)	No. of farm households (10^3)	Average farm size (ha)	Average farm family size (people)
1960	2,205	14,559	2,350	0.86	6.2
1965	2,275	15,812	2,507	0.91	6.3
1970	2,295	14,432	2,483	0.93	5.8
1975	2,240	13,244	2,379	0.94	5.6
1980	2,196	10,827	2,155	1.02	5.0
1985	2,144	8,521	1,926	1.11	4.4
1990	2,109	6,661	1,767	1.19	3.8
1995	1,984	4,883	1,499	1.30	3.3
2000	1,888	4,032	1,384	1.36	2.9
2002	1,863	3,591	1,280	1.45	2.8

Source: Ministry of Agriculture and Forestry, 1960~2002.

The Korean Agricultural Extension System

1. The Mission and Goals of Extension

1) The Mission of Agricultural Extension Services

The *Rural Development Law* describes how the objectives of the organization are to contribute to the development of farmers' welfare through conducting agricultural experiment and research, transfer of scientific techniques and knowledge on agriculture and rural life, and training of rural leaders and farmers.

The followings are specific missions of the Rural Development Administration:

(1) To conduct experiments and research for developing agricultural technology concerning food crops, livestock, veterinary medicine, horticulture, sericulture, farm machinery, etc., and for developing farm management;

(2) To transfer scientific techniques and knowledge for improving agriculture and rural life, especially through informal education and demonstrations of the effects of scientific knowledge and technology on agriculture and rural life, and through fostering rural people's organizations; and

(3) To train farmers, local leaders, rural youth students, and teachers in agricultural high schools as a part of cooperative education, as well as research and extension officials in agricultural technology organizations.

2) The Goals of Agricultural Extension Services

The efficiency of farm management for meeting the demands of competitive agriculture and substantial increases in farmers' incomes are key concerns of Korean agricultural extension services. Extension activities for agro-technology transfer in Korean are based on the following objectives:

(1) To attain stable and labor-efficient production of major grain crops;
(2) To improve the quality and cost-efficient production of cash crops and livestock;
(3) To maintain safe and pollution-free crop production and adequate pest management;
(4) To create extra revenues by exploiting high-tech agriculture;
(5) To provide technical support for the production of special local or export markets; and
(6) To develop sustainable agriculture.

To accomplish the above goals and objectives, the area-specific model projects for higher incomes and new technologies have been implemented at the national as well as regional level.

2. Agricultural Extension System

1) Organizational Set-up

The Rural Development Administration (RDA) is the central government organization for agricultural research and extension services. It was first established in 1906 as the Agricultural Demonstration Station, and subsequently renamed the Agricultural Experiment Station in 1929, the Institute of Agricultural Improvement in 1947, and the Institute of Agriculture in 1957. It was re-organized as the Office of Rural Development (ORD) in 1962, and, it was re-constituted in 1994 in its present form of the RDA by incorporating four national offices from the Ministry of Agriculture and Forestry (MAF). The organizational structure of RDA is presented in Fig. 1.

The Rural Development Administration (RDA), an outside arm of extension and research of the MAF, is the national-level headquarters for rural development planning and implementation in Korea. Headed by an administrator, the RDA maintains various extension programs through one bureau and two offices: the Extension Service Bureau, the Farm Management Office, and the Public and Technical Information Office. There are four divisions under the Extension Service Bureau.

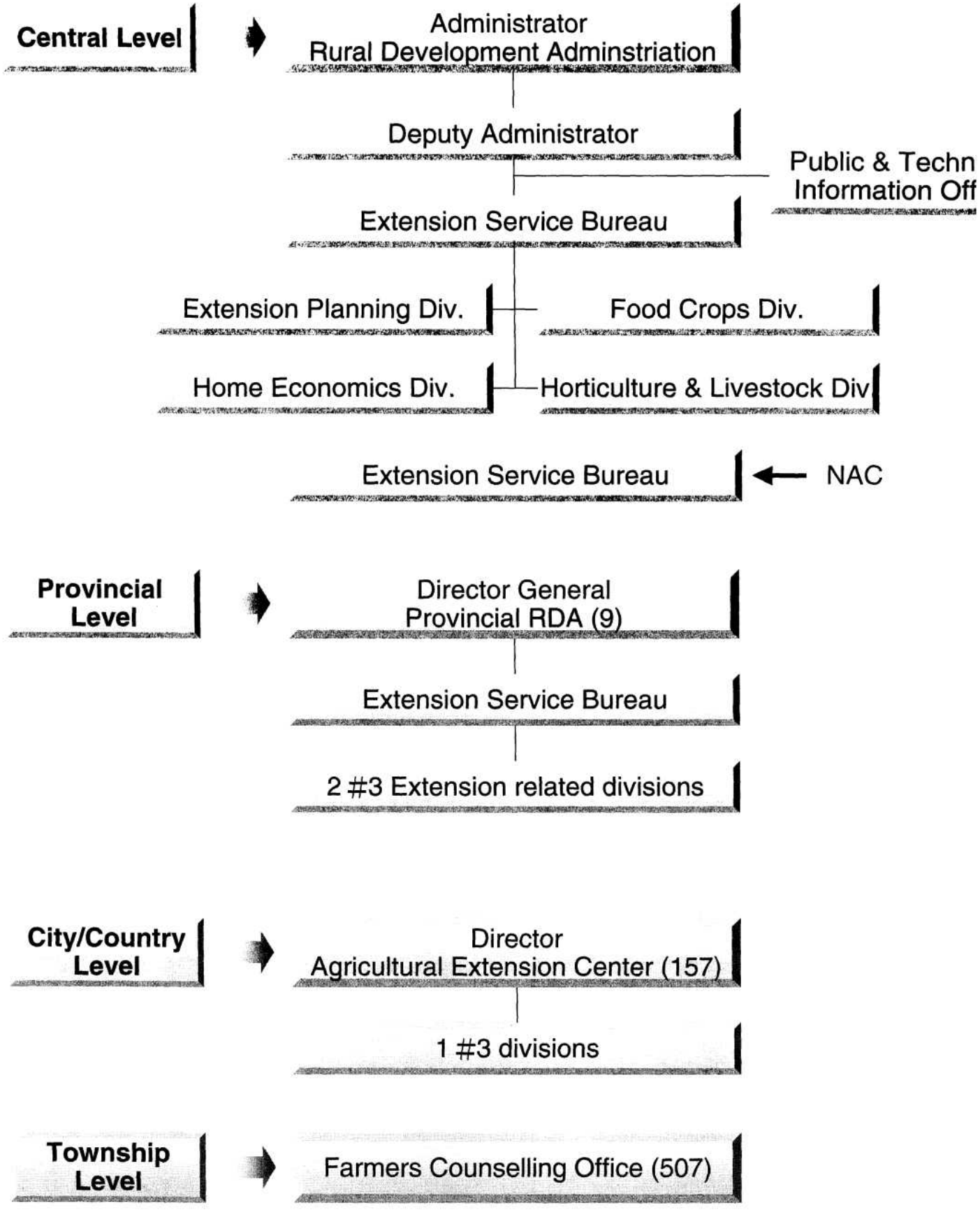

Fig. 1. Organization for agricultural extension services

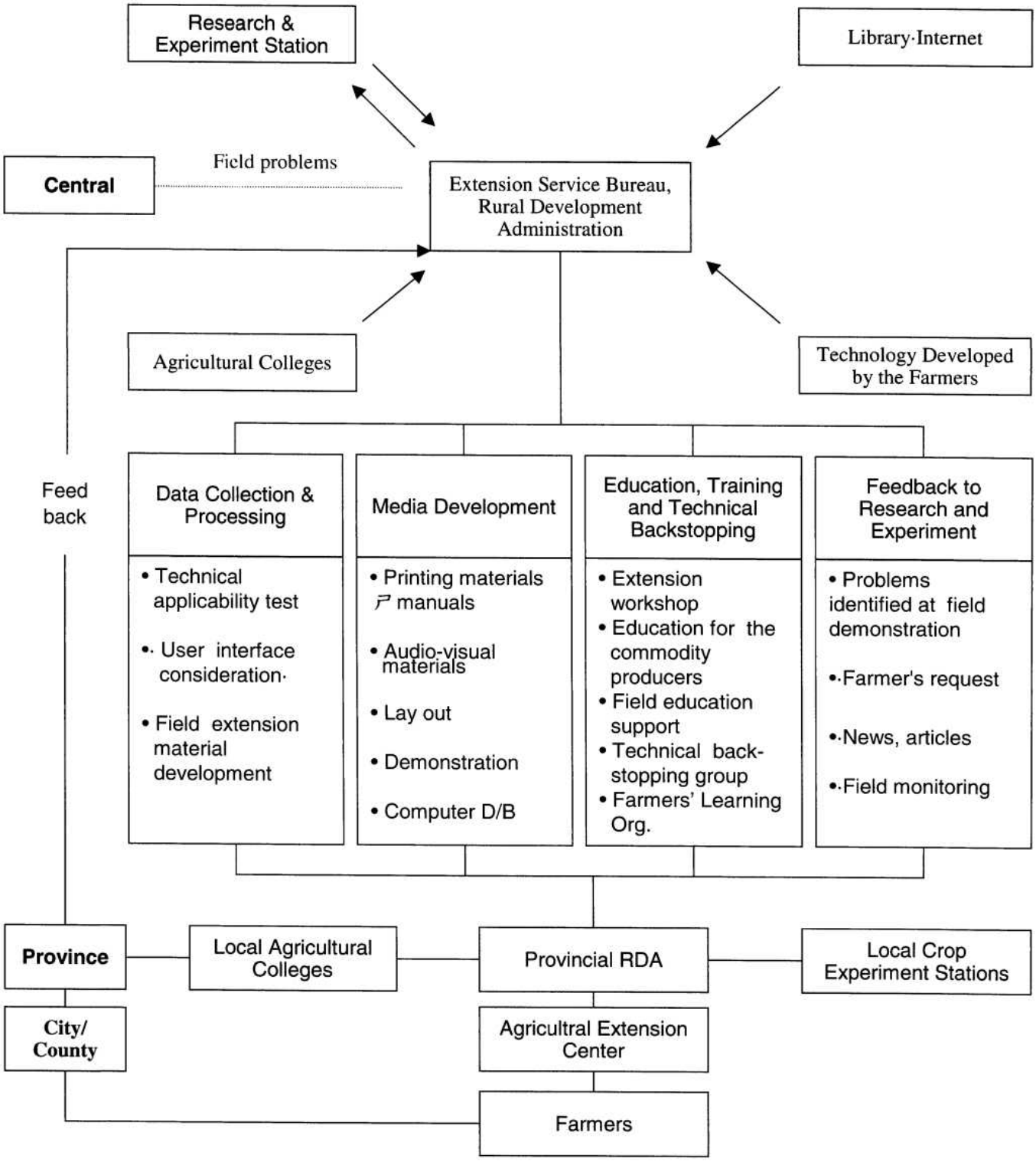

Fig. 2. Technology transfer system for extension

As shown in Fig. 2, in the Extension Service Bureau, the Extension Planning Division is responsible for budgeting, personnel management, national extension activities as well as integrated community-based rural development, while the Home Economics Division is responsible for matters related to rural welfare. Other divisions, which are staffed by production-oriented specialists, have two subject-matter divisions namely the Food Crops Division and the Horticulture and Livestock Division.

The Farm Management Office supports both research and extension of farm management and computing services with its two divisions. The Public and Technical Information Office, popularly known as the "Agricultural Information Center", is responsible for all information services of the RDA, particularly the preparation, production, distribution, and utilization of extension teaching materials. The Technical Training Division which was moved to the National Agricultural College of the RDA in 1999 is responsible for training extension workers and farmers throughout the country.

The Provincial Rural Development Administrations (PRDAs), numbering nine in all, represent the provincial organization of the RDA, and the PRDAs are the outside arms of the provincial government and are consequently controlled administratively by governors.

The 157 City/County Rural Extension Centers are administratively and technically under the hierarchical control of the PRDAs. But at the same time, each extension center forms an outside arm of its respective city/county government. The County Extension Center, however, is considerably dependent on the county government in many ways, including financing, which is probably the most important aspect of agricultural extension work.

There are real grass-roots extension organizations under the jurisdiction of the county extension offices called "Farmers Counseling Offices" totaling 507 across the country at the township (*Eup/Myun*) level. Each office is geographically responsible for extension programs. These local extension offices make plans and carry out localized programs, and at the same time execute national extension programs financed by the national government.

2) Characteristics of the Organizational Set-up

Characteristics of the organizational system can be summarized as follows.

(1) Since both research and extension functions are integrated under the same administrator of the RDA, the results of agricultural research and experimentation and of newly developed technologies can be more effectively and efficiently disseminated to farmers in a timely manner through the nationwide extension channels and networks. Problems which occur in the course of extension activities can be easily adopted as research projects.

(2) Results of research are thoroughly examined, screened, and subjected to economic analyses by the research and extension joint evaluation committees. These results are reflected in agricultural policies and extension services. Related extension specialists are always aware of current on-going research programs and actively participate in research planning and evaluation activities.

(3) The participation of researchers in extension programs is not only helpful for technical dissemination but also provides very useful information for improving agricultural research programs. Researchers have opportunities to review the applicability of their research findings in the field through their involvement in extension activities such as field observation trips, training programs for farmers, evaluation meetings, etc.

(4) The institutional cooperative relationship of the extension service system with provincial and local governments, generally known as general administrative agencies, is another characteristic. With this relationship, extension programs are not only easily integrated into comprehensive rural development policies, but also supported from the administrative agencies.

(5) In addition, this close cooperative relationship exists between the extension program and administrative policies at all levels, and the budget for agricultural extension services comes from central, provincial, and city/county governments in collaboration with each other.

Figure 3 shows the linkages of research and extension for agricultural technology transfer in Korea.

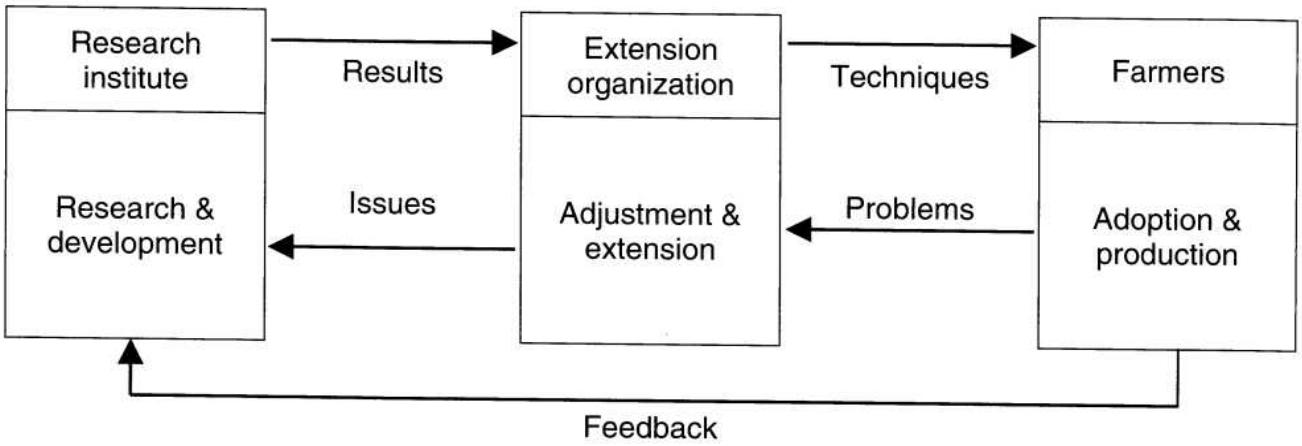

Fig. 3. The Linkage of Research and Extension (Source: Rural Development Administration).

3. Extension Agencies, Personnel, and Budget

1) Extension Agencies

Numbers of extension agencies included 181 at the city/county level and 1,464 at the township (*Eup/Myun*) level in 1987; however, the numbers of extension offices were respectively reduced to 157 and 507 in 2002, a year after localization was implemented as shown in Table 2.

Table 2. Number of extension agencies by selected year

Year	Central	Provincial level	City/County level			Township offices	Remarks
			Total	City	County		
1987	1	9	181	42	139	1,464 (22)	A year before the 1988 Seoul Olympics
1994	1	9	182	46	136	1,302 (28)	Preparation for localization
1997	1	9	162	69	93	1,415 (9)	Implementation of localization
1998	1	9	157	67	90	534 (18)	
2000	1	9	157	67	90	527 (9)	
2002	1	9	157	67	88	507 (9)	

Source: Rural Development Administration.

2) Extension Educators

Extension educators are central or local government officials, and the administrator of the RDA used to take charge of the local extension personnel administration, directly or indirectly, including appointments, positioning, and promotions. However, since 1997, most personnel affairs have been managed by the governor of each local government.

The number of extension educators has steadily increased to reach 7,979 by the end of 1990. After localization of extension services in 1994, administration authority was transferred from the central to local governments. Again in 1997, the government decided to change the nomination right of field extension personnel from the central to local governments. At present, there are 4,728 extension officials throughout the country, as shown in Table 3.

Table 3. Changes in number of agricultural extension educators in selected years

Year	Total	Central	Provincial	City/county	Remarks
1962	3,173	75	180	2,918	Enactment of the *Rural Development Law*
1970	6,360	73	236	6,051	Rice and barley guidance
1981	7,979	105	226	7,648	Farm income guidance
1997	6,839	91	289	6,459	Implementation of localization
1998	5,545	85	241	5,219	1st restructuring
1999	5,032	71	235	4,726	2nd restructuring
2002	4,728	71	228	4,429	

Source: Rural Development Administration.

There were 71 extension educators at the national level or at the RDA, mostly senior subject-matter specialists, in 2002. There were 228 extension personnel at the nine provincial RDAs, and 4,429 extension educators stationed at the 157 county extension offices.

Percentage-wise, approximately 6% of the total numbers of extension personnel are stationed both at the national-level (RDA) and at provincial-level agencies. The remaining 94% of the total extension personnel work directly with rural people, being stationed at the local level of either county extension offices or their branch offices. An extension educator covers eight villages of the lowest administrative unit with 289 farm households and 420 ha of farmland on average.

3) Extension Budget

Experience has shown that in allocating operational authority and responsibilities, subsidies are key decisions which should devolve to the lowest possible level of government, consistent with the efficient use of funds. All levels of government must be willing to involve farmers and other stakeholders in project planning, design, and implementation. Furthermore, funding must follow function: local authorities must have resources commensurate with their added responsibilities.

Recent trends in sustainable agriculture as defined as ecologically sound, economically viable, and socially just and humane; have received considerable attention in recent years from environmentalists, agriculturalists, and consumers. Extension services need more funding and greater manpower to meet emerging needs of environmentalists, agriculturalists.

and consumers; however, the extension budgets by year, especially after localization in 1997, do not reflect these needs as shown in Table 4.

Table 4. Extension budget by year

Year	Budget	Source				Remarks
		National		Local		
		Amount (10^6 Won)	%	Amount (10^6 Won)	%	
1991	112,735	11,897	10.6	100,838	89.4	
1992	131,421	14,160	10.8	117,261	89.2	
1993	145,090	17,867	12.3	127,223	87.7	
1994	207,275	20,691	10.0	186,584	90.0	
1995	285,600	92,600	32.4	193,000	67.6	
1996	360,128	90,975	25.3	269,153	74.7	
1997	432,894	97,614	22.5	335,280	77.5	Localization
1998	263,918	82,177	31.1	187,741	68.9	
1999	258,615	91,173	35.3	167,442	64.7	
2000	240,878	85,260	35.4	155,618	64.6	

Source: Rural Development Administration.

4. Agricultural Extension Programs

1) Food crops: rice, barley, soybean, etc.

Improvements in soil fertility, fertilizer use, and environmental-friendly agriculture.

Pest forecast and control, and integrated pest management.

Plant protection from meteorological calamities.

2) Cash crops: vegetables, flowers, fruits, and special-purpose crops.

Greenhouse cultivation, environmental control, tissue culture, low-input sustainable agriculture, and pollution control.

3) Livestock

Animal husbandry and livestock sanitation.

4) Home economics

Home management, development of rural women's ability, home environment, and nutrition.

5) Fostering of future farmers

4-H club members and farmer successors, rural leaders, and women.

6) Extension personnel training

Extension workers must have highly specialized knowledge, newly developed techniques, and experience. Through continual professional training, they must be able to carry out more-effective and productive extension services for farmers. The RDA has therefore made continual efforts towards these needs through in-service training, workshops at advanced pilot farms, professional training, and overseas training according to the *Regulation on Specialization of Extension Personnel*.

7) Farming training programs

Various year-round training programs at the national, provincial, and county levels are furnished to farmers to improve their farm management and production skills including commodity-specific technologies and machine operation. Intensive rural education on a nationwide scale is delivered during the winter season of January and February, which is not a busy time for farmers, whereas during summer, regular technical lectures on region-specific commodities are organized jointly by the RDA and the Korean Broadcasting System.

The Korea National Agricultural College of the RDA has provided a 3-year specialization course to future elite farmers since 1997.

Impact of Technology Transfer on Economic and Sociocultural Life

1) Agricultural extension programs as a way to create a foundation for social development and increased farm incomes

In the latter part of the 1950s when the agricultural extension program was adopted for the first time, the program instituted a democratic extension method compatible with the given sociocultural environment of Korea along with the general enlightenment of discouraged and poverty-stricken rural people due to the havoc of the Korean War, to bring them new hope and encouragement.

In the 1960s less-susceptible traditional farmers began to apply modern scientific farm techniques obtained from extension programs to their own farming. Rural housewives awakened from traditional doldrums and began to learn rationalization of rural lifestyles as well as home improvement and strived to raise their social status by means of cooperative activities in their community. In the meantime, a corps of young rural people developed the leadership abilities to grow into able future farmers through the 4-H program. Thus, the foundation of the agricultural extension program was firmly laid during this period of time.

In the decade of the 1970s the extended diffusion of newly developed high-yield rice breeds eventually revolutionized farm technology on the one hand, while cooperative farming generalized by means of cooperative production on the other, markedly raised productivity. Recognizing the advantages of scientific farming through experience in cultivation of new breeds, farmers have come to willingly apply new techniques not only to rice farming but also to other fields of farming in pursuit of extended farm production. Particularly, the progressive consciousness possessed by advancing farmers and continued improvements in farm know-how owing to extension programs have consequently produced tremendous impacts on the successful implementation of rural development.

In the 1980s, consumers with greater bargaining power, which had improved with the national economy, were searching for quality vegetables and animal productions; the agricultural extension program responded to farmers with arrays of diverse vegetables and animal production even in the off-season.

As a result of agricultural extension programs, farm earnings have steadily grown 11% to 15% annually. An average farm household income was US$ 3,847 in 1980, jumped to approximately US$ 20,000 in 2001. Agricultural income comprised 47% of total farm household income in that same year.

In this way, agricultural extension programs have established a strong foundation for sustained rural development as a whole by fulfilling a social education function aimed at the development of human resources, particularly of the rural poor over the past decades.

2) Returns on investment of extension services in Korea

One study indicated that the socioeconomic returns were quite competitive in cases of agricultural research with a 44.82% internal rate of return and were very high in cases of extension services with a 207.82% internal rate of return.

Agricultural production responds to agricultural research shocks about 4 years after a shock occurs. The magnitudes of the impacts increase until a peak is reached 9 years after the initial expenditures, and then the impacts decline to a negligible level after about 20 years. These lag times are consistent with the usual literature on this research, which reports lags of 7 to 30 years.

Agricultural production immediately responds to an agricultural extension shock and declines to a negligible level after about 4 years. Thus the lag times are much shorter than those from research shocks.

To develop the agricultural sector, the Korean government must invest more in the agricultural extension sector as well as in research.

Future Tasks and Directions

Since the early 1990s, farmers in Korea have realized the fact that increased production might not lead to increased incomes. Because of this, farmers desired improvements in management and marketing. Extension services identified the changed needs of farmers for new knowledge, information, and technology in their farm business operations including management and marketing. And extension educators have begun to emphasize cost-down production through efficient mechanizations which may solve labor shortages, low-input techniques such as reduced chemical application to protect the environment, and water-conserving culture to prevent development of losses.

Increased cooperation among the central, provincial, and local levels of government after localization of extension services in January 1997 should be strengthened. Provincial-level monitoring and supervision should be enhanced for more-effective agricultural extension services to meet the changing needs of farmers in the future.

Finally, we must consider consumers' needs for food safety and good quality as the final clients of agricultural extension services.

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The Role of Farmers' Organizations in Agricultural Technology Transfer in Malaysia

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Introduction

This paper relates the experiences of Malaysian farmers' organization in contributing to the country's program for transforming the agriculture sector. The paper highlights the challenges faced by these organizations in the process of technology prospecting, adoption, and transfer.

Farmers Organizations in Malaysia

The farmers' organizations (FOs) in Malaysia are modeled after the Taiwanese farmers' associations. FOs are corporate bodies registered under the *Farmers Organisation Act* of 1973. State-level FOs are secondary-level FOs, while the national FO is a tertiary-level FO. Legally, the objectives for the formation of FOs are the promotion of the economic and social interests and wellbeing of their members and member-units through the direct participation and by carrying out those activities that are required for the achievement of the objectives. Those activities include:

(a) Providing extension services and training facilities to equip farmers with the technology for the advancement of agriculture, horticulture, animal husbandry, home economics, agribusiness, and other commercial enterprises;

(b) Expanding agricultural production among farmers and small holders so as to promote greater diversification and commercialization of agriculture and to promote agribusiness;

(c) Providing farm supplies, farm mechanization services, and credit facilities, and promoting greater investment in agricultural and economic pursuits, facilities for rural savings, marketing storage warehousing and drying services, transportation facilities, and processing facilities for agricultural products;

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(d) Facilitating capital formation and promoting investment among farmers through equity participation in commercial and agribusiness ventures;

(e) Assisting members in acquiring land to undertake land development projects; and

(f) Promoting and stimulating group action through community projects and facilitating leadership development.

The FO movement in Malaysia has 650 members. In recent years, the movement has experienced trends of decreasing numbers of farmers, and increasing numbers of part-time farmers (who derive income from both agriculture and non-agricultural activities) and aging farmers. FOs are actively campaigning for youth and also professionals involved in agricultural production to join the organizations.

FOs in Malaysia are overseen by a statutory agency under the Ministry of Agriculture, which is the Farmers' Organization Authority (FOA).

In Malaysia, apart from the area farmers' organizations, the Department of Agriculture also directly organizes farmer groups.

Agriculture in Malaysia's Economy

Malaysian agriculture began to receive greater attention again after the regional financial crisis of 1998, after being sidelined in the early 1980s and mid-1990s when the country embarked on rapid transformation of its manufacturing and service sectors. Agriculture achieved an annual growth rate of more than 4% during the 2 decades up to 1990, and at a rate of 2% in the 1990's, at which time, other sectors including manufacturing, finance, transport, communication, and government services all grew faster than the agricultural sector.

During the regional financial crises of 1997, the agricultural sector (particularly the export sector) became the savior of the country's balance of payments. Agricultural exports, particularly palm oil, enjoyed high prices during that crisis period. The financial crisis also highlighted the situation with the rapidly growing food import bill of the country, which was around RM 12 billion in 1998. The major components of food imports were mainly feedstuff, processed food, fruits, vegetables, meat, and dairy products. Despite the net continued increase in the absolute production of agricultural commodities and food products, the country continues to be a net importer of food. The food bill grew to the record-high figure of RM 13 billion in 2000.

Research and Development in Malaysia

One of the implications of the reduced focus on agriculture in the 1980s to the mid-1990s was the limited development funds allocated to research and development. The majority of allocations for agriculture as expected were expended to fulfill the socieconomic objectives of plant and primary production. This can be attributed to the greater number of researchers based on fulltime equivalency who are involved in plant production research.

However, out of the total allocation given for R&D, only about 15-20% was allocated for primary production of plants and animals, a figure considered rather low. The relative amount expended by the private sector for agriculture (either through local or foreign investments also showed declining trends over the years 1992-1998. Most agricultural allocations have been expanded for current expenditures (Mastec, 2002).

Despite a vast array of technological innovations in agriculture both regionally and globally, indigeneous or home-grown inventions and technological improvements in fish, fruits, and vegetables were limited, with the exception of paddy rice (Fatimah, 2002). Recognizing that the key to technological advancement is R&D, funds for R&D were increased from 0.2% of GDP in 1995 to 0.4% in 2002. The allocation of an IRPA (Intensified Research Priority Area) fund for agro-based industry research was 25% of the total value of funds for research. But then the major issues and orientation of the research, i.e., whether it is finding solutions to production, processing, or marketing problems, or moving towards economic, social, and environmental well being of the society at large, have had different impacts.

The Third National Agriciultural Policy

(NAP3, 1998–2010)

In 1998, Malaysia launched the NAP3. Under the NAP3, agriculture was designated the third engine of growth for the country, after the manufacturing and service sectors. The food sector is being given special emphasis.

The NAP3 addresses future needs for agriculture and food production in Malaysia, including:

- A requirement to improve food security;
- The need to improve agricultural efficiency and productivity;
- A desire to reduce particular imports;
- The need to encourage additional private sector investment in food production; and
- The requirement for more-sustainable uses of nature resources.

The NAP3 recognizes that the forces driving future change in the agricultural and food industries will need to embrace:

- Changing consumer tastes and behavior;
- Globalization influences;
- Changing market structures;
- Advancing technologies;
- Changing regulatory requirements;
- Increasing competition and production efficiency pressures; and
- Environmental concerns.

Food Production Plans

The national food production plan gives strategic emphasis to three food groups, namely the crop group comprising paddy rice, fruits, and vegetables; the livestock group comprising beef, poultry, and dairy; and the fish/aquaculture group.

The productive capacity of these sub-sectors is currently limited by a number of structural constraints, including:

- Uneconomical farm sizes;
- Continuing traditional and semi-commercial approaches to food production;
- Lack of effective integration between production and downstream components of the food chain;
- Acute shortages of labor; and
- Lack of private sector investment in commercial food production, resulting in slow technological and business advances.

Transformation of Agriculture

In order to give impetus to implementation of the NAP3, Malaysia's Ministry of Agriculture (MOA) launched a Transformation Programme. This transformation process is to be implemented via two main strategies, namely through the modernization of existing producers and increases in private sector investment. Some enablers related to land, infrastructure, technology, financing, incentives, and market development have been established to support this transformation.

In order to provide for more-structured development, production zones for crops, livestock, and fisheries have been developed based on the best possible conditions for production and development. In relation to the lack of land, 70,000 ha has been identified as permanent areas for food production following the consent of various states governments. This is a step towards promoting private sector involvement in food production activities on a large scale.

Various other steps have been taken to increase private sector participation in food production including inviting participants to take part in smart-partnerships with government agencies under the MOA in the implementation and development of new and existing food production projects, establishing Business Development Centres as one-stop centers to facilitate easy retrieval of information and technical assistance, improving tax incentives schemes, increasing the number and quantity of loans under the Fund for Food Scheme, and intensifying entrepreneur development programs.

Development of a venture capital loan scheme and an Agricultural Insurance scheme.

The Private-Public Sector Coordination Council has been established in order to strengthen the cooperation mechanism between the government and private sector to ensure the success of agriculture development and a national production plan for food. This council is chaired by the Prime Minister himself with members comprised of state and federal government officials and members of the private sector.

Modernization and commercialization of the smallholding sector are implemented through development projects that are comprised of *in situ* group farming and which have a business approach. This step is taken to transform their agricultural activities into profitable business ventures, especially with the collective resources and efforts among members. The implementation of these projects is strengthened via the MOA's approach whereby all agencies and departments under the MOA channel advisory, management, and technical assistance in an integrated and planned manner.

Quality, safety, and product presentation are to be emphasized in the marketing of food products to ensure acceptance by consumers, both local and overseas. Other than the cost of production, factors that determine the competitiveness of national food production activities are also given emphasis. In this matter, the MOA has taken steps to develop an accreditation scheme and SPS programs for crop, livestock, and fish production to be practiced by producers. A national branding standard (Malaysia Best) has also been developed with a view to increasing the market values of products, especially those intended for export markets.

The emphasis of the transformation program for the food production subsector is on the ability to use the latest technologies and information. In this regard, activities of technology transfer, either from research findings of local R&D institutes and universities or imported technologies via technology acquisition activities, are being intensified. Priority areas of research for local R&D institutions such as MARDI, FRI, and VRI requiring budgetary resources have been identified. R&D institutions are also required to develop programs and facilities such as technology incubators in order to hasten the transfer, commercialization, and uptake process for the technologies they generate. As to development of the food production sector, the efficiency of dissemination and utilization of all forms of required information has been intensified via establishment of the National

Agricultural Information Centre (Knowledge Centre), various websites such as Agrolink, and agricultural portals such as FAMAX/Agric-X.

The utmost important element required to ensure the success of the development of the food and agricultural sectors, is having knowledgeable and skilled human resources. Apart from existing training institutes run by the Department of Agricultura, the MOA is in the final stages of establishing a National Agricultural Training Centre with a view to developing professional managers and entrepreneurs.

The focus of the transformation process is to transform the image of the agriculture sector towards a more-modern, dynamic, large-scale, commercial, and competitive entity. Both producers from the private and smallholding sectors have been made aware of the changing global scenario that requires them to be more efficient and competitive as has been the case with the manufacturing and service sectors.

Transformation of Traditional Farmers

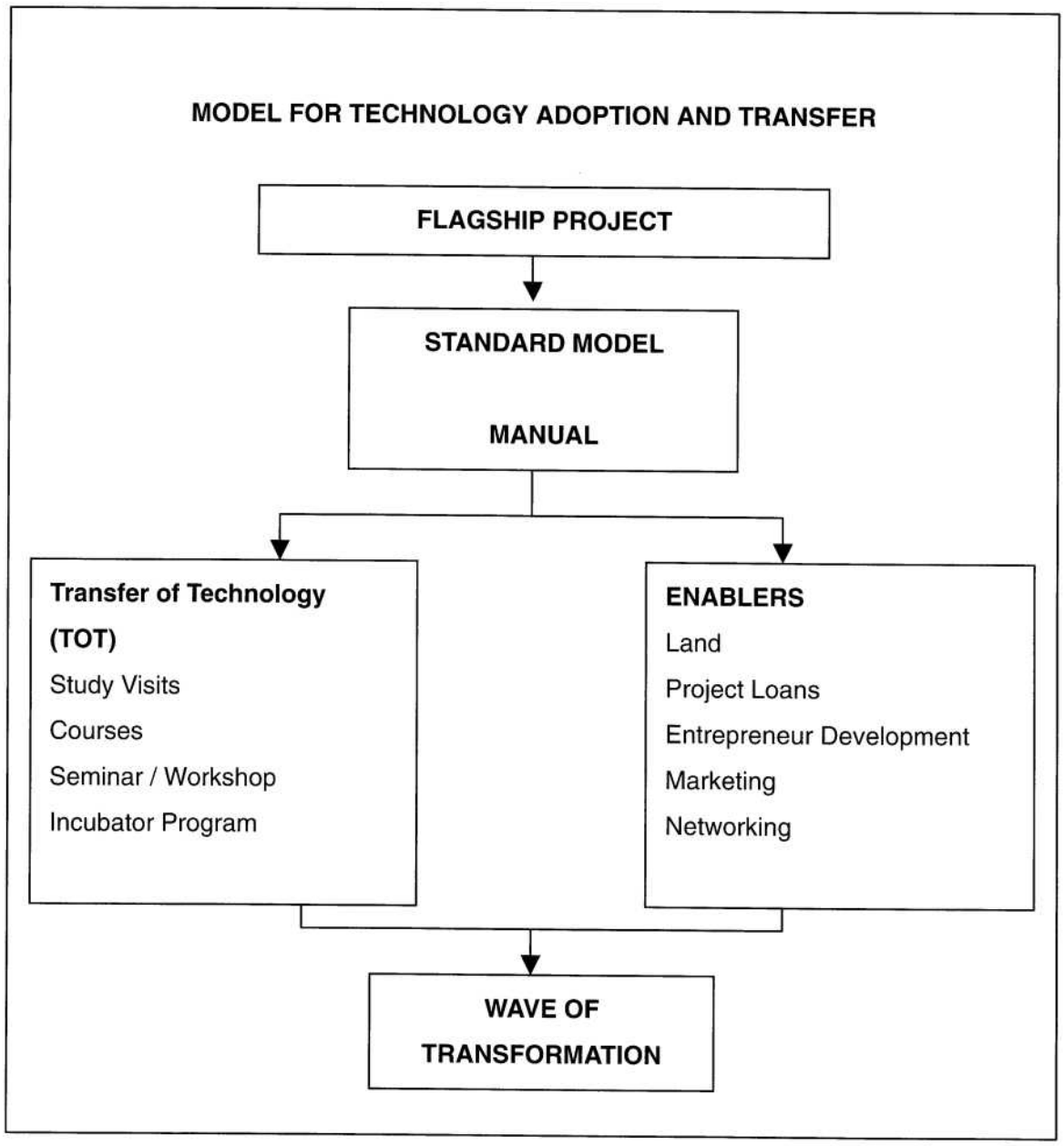
The biggest challenge in transformation is still a social issue: changing the mindset of traditional farmers. We approach this by attempting to visually and physically prove to the farmers the benefits of change close to where they are, by creating model farms in their vicinity. In this respect, the FOA was directed to engage 268 AFOs under its charge to mobilize their 650,000 members throughout the country, to bring to them the message of transformation.

In 2001, the FOA was directed to develop 48 model projects covering paddy rice (10), fruits (11), vegetables (8), aquaculture (9), and livestock (9), involving 41 AFOs. The projects are required to adopt the latest technology, and their best performance is expected to be used as a benchmark against the industry's best. Development of individual projects requires the involvement of departments and agencies under the MOA, especially the relevant department and agency responsible for the subsector under the MOA's team approach in the spirit of MOA-Inc.

The technology and practices, which are supposed to be the latest, for the respective projects are to be adopted from the relevant departments and agencies. In each of these model projects, the selected AFOs are to work by following a prescribed manual and schedule, and adopting GAP (good agricultural practice) systems. FOA/FOs are expected to replicate the successful model for target farmers.

Transformation Approach

The model being adopted to implement Agriculture Transformation is illustrated in the following chart.



Model Projects

In late 2000, the FOA was directed to develop 48 model projects in the five subsectors of paddy rice, fruits, vegetables, livestock, and aquaculture. These are regarded as FOA flagship projects, to be given special priority and attention by the FOA. Other departments and agencies under the MOA were also required to accord special assistance in their respective areas involving the supply of certified quality seeds/planting materials, fry or breeder animals, and technology advisory support on production, diseases, pests, financing, and marketing.

The model projects are expected to incorporate the best of the industry practice in respect to technology application of such production projects. The technology adopted is expected to impact the maximization of productivity and cost-savings (benchmarked on the industry's best) as well as taking into consideration food safety and environmental aspects. Technological aspects are related to high-quality seeds, planting materials, fry and breeder stock, mechanization and automation, production methods and work processes, sanitary and phytosanitary practices, and harvesting and post-harvest handling.

As the FOA is charged with the project development, it in conjunction with FOs, prospects for technology from research institutions, departments, universities, suppliers, and the private sector involved in the subsectors. Visits are also made to similar enterprises in neighboring countries. A commercial-scale project model is usually not found in research institutions or government departments, but can be found in private sector operations.

FOA's flagship or model projects must also incorporate the following features:

- Industry's best practice technology;
- Commercial-scale and market-oriented practices;
- Certified GAP (good agricultural practice);
- Bio-security;
- Good management;
- An operation manual and checklist;
- A business plan; and
- The MOA-Inc. approach (MOA-Inc.'s team approach).

The design and specification of the respective project infrastructure, machinery, equipment, and requirements are a highly technical exercise in itself. FOA's procurement procedure for tendering works and supply requires appointment of consultants: civil and structural consultants and mechanical and engineering consultants. These consultants in fact depend on FOA's officers to provide them with general concepts and details of the

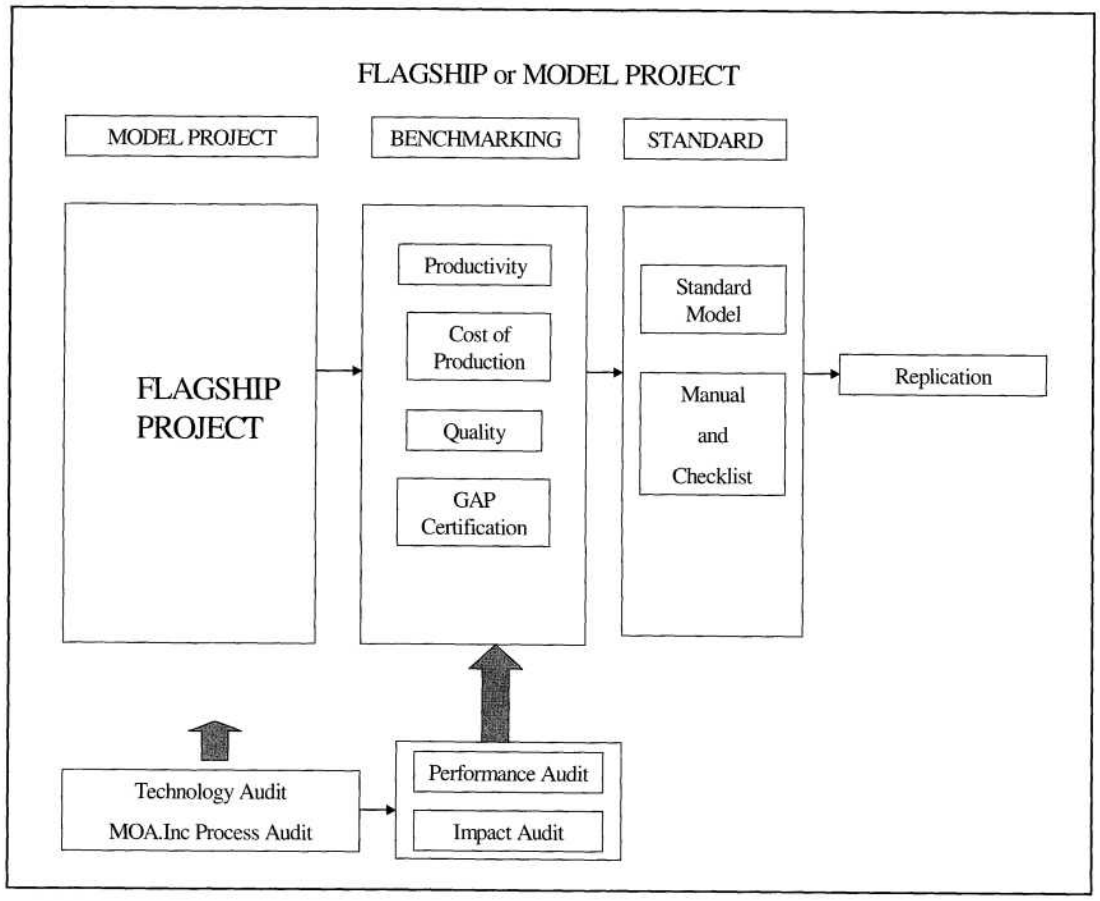
design. When the FOA technology prospecting team visits various projects, it even includes the consultants.

Evaluation of the design and specifications at various stages of their drafts is performed by a Technical Committee comprised of FOA's production division officers, who are specialized officers from relevant departments and agencies of the MOA. Sometimes, the FOA also invites private sector executives to attend the discussion to present their views.

Apart from the design and specification of projects and the procurement procedure which might not realize the desired designs, the next challenge is the operationalization of the project with new machines and equipment. Although the project management and workers may have had some training in similar projects before this, familiarization with a new operation and especially discovering deficiencies and defects in the project design can involve additional expenses and can limit attainment of the benchmark target. The process of achieving a stabilized standard model is slow, and sometimes difficulties arise from human and material deficiencies.

The MOA wants assurances that the model projects are indeed models of technology and GAP practices, and has instituted technology auditing and MOA-Inc. process audits.

A wave of transformation is expected from replication of successful models, where prospective takers only need to start from the standard model and manual of operation of the prospects. This process is illustrated in the chart below.



Transfer of Technology

Transformation Business Plan

All AFOs are required to prepare a Transformation Business Plan (TBP) for their respective operational areas. The TBP reviews and compiles the current status of crops, demographic profiles of farmers and producers, current agricultural practices, land availability, and new agricultural enterprises and trends in agricultural modernization in the AFO's area. The choice of the transformation approach and modernization efforts are decided based on situational SWOT analyses of the area. Having identified the areas to be modernized, suitable standard models are also identified.

Communication Process

Basically, the AIDA (awareness, interest, desire, and action) communication process model as illustrated below is adopted.

Transfer of Technology (TOT) – Communication Process

	Desired Response	Strategy
Communication Model	**Awareness**	• Lectures • Fliers • FO news bulletins • Seminars • Village-level meetings • General assembly meetings
	Interest	• Study visits • Success stories
	Desire	• Visits • Courses
	Action	• Courses • Attachment courses • Incubator programs

Awareness

Efforts at raising the transformation awareness and interest and keeping them at a high level are continuously undertaken at every available opportunity and occasion. Transformation issues are made standard agenda in village-level meetings, AFO Board of Directors meetings, and during the Annual General Meeting. Fliers and FO news bulletins also discuss agricultural transformation and technology.

Success stories

Success stories via VCD (video cassette disc) presentations are communicated to the target group during the AFO AGM Farmers Convention, and Farmers Day celebration visits are also made to farms of successful farmers.

Courses and attachment training

Courses are also organized for interested farmers who desire to undergo more-formal learning, to gain appreciation and knowledge of the particular modern agriculture production model. For the committed farmer-entrepreneur, FOA/FOs also arrange for them to undergo attachment training for the full cycle of production (related to marine shrimp farming, poultry closed-house operations, or chili/tomato production by fertization) or on a modular scale related to particular activity or tasks. Attachment training is arranged at FO model projects or at the farm of a successful farmer. Champion farmers are also invited to lecture and do demonstrations.

Incubator program

Departments and agencies under the MOA also run incubator program for production operations related to capital-intensive, technology-based production such as mentioned above (vegetable production by fertization and fish and shrimp fry production). Under the incubator program, interested producers are allowed to use the complete production facilities for a certain period of 6 months (one cycle for fertization and shrimp farming) or 2 years, renewable for another 2 years, and an optional 1 year (2 + 2 + 1 years). The entrepreneurs have to use their own working capital for the operation, and have to pay rental and utility bills, but the relevant departments and agencies provide technical support to the entrepreneur.

Networking and support group approach

FOA/FOs also organize focus-group discussions among farmer-entrepreneurs involved in the same type of production enterprises. Such discussions are also attended by extension officers, research officers, and even suppliers. Practicing farmers have admitted that with effective moderation, the sessions have been very productive compared to the conventional lecture approach. The exchange of experiences among producers and with other resource persons provide proven solutions to some problems experienced by certain farmers. Extension workers and research officers also gain from the sessions. Their interactions inadvertently develop into effective networks and support groups.

The more-successful entrepreneur farmers have even established an exclusive club at the behest of the Minister. The club organizes talks by invited speakers, and also visits organizations and farms to add to their knowledge and networking. Currently two main clubs have already formed: the Farmer Entrepreneur Club and Paddy 10 Metric Tonnes Club.

Mentor-student

FOA/FOs have also organized successful farmers to collaborate with new farmers, based on the mentor-student model. There is the case of a young successful large-scale vegetable producer collaborating with four new producers who do not yet have sufficient experience and market contacts.

Conclusions

The transformation process may involve a complete package from just productivity improvements to full-fledged modern farms practicing sustainable farming. The FOA/FO's transformation program with respect to the TOT and its enablers is summarized in the following chart.

Transformation Program

Transformation	TOT	Enablers
Productivity	1. Manual 2. Advisory services	• Technology package • Supervised farm credit • AFOs as integrators
GAP Certification	1. Guidance 2. Advisory services 3. Lectures 4. Courses	
Modernizing Agriculture Practice	1. Standard model 2. Manuals 3. Success stories 4. Visits 5. Courses 6. Networking	• Incubator programs • Enablers
Entrepreneurs	-- as above --	• MOA–Inc. support • Agriculture loans • Mentor-student • Enablers: land

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Impact of Technology Transfer on Economic and Socio-cultural Life of Rural Poor in India

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Introduction

Agriculture continues to be the most crucial sector of the Indian economy in spite of the fact that its contribution to Gross Domestic Product (GDP) has declined to 26 % by 2000-01 (at 1993-94 prices) from 59 % in the year 1950-51 (Table 1). However, it provides employment to around 58 % of the workforce which is keeping it at the centre stage of the Indian economy. Any change in the sector in terms of policy, technological or institutional, have a multiplier effect on the entire economy and its population. Agricultural sector besides providing labour to the industry which is slowly progressing in India also provide food to the population and workers at affordable prices to keep the prices under control in the economy. Agriculture also provides raw materials to the industry like textile, jute, food, sugar, food processing and so on. Besides this, the agricultural sector is the biggest market for low price and middle price consumer good, including durable goods as well as capital goods like agricultural implements produced in the industrial sector thus helping in the growth of industrial sector. Agriculture has also contributed towards exports; it has helped to substantially cut down on imports of foodgrains, thus improving the foreign reserves of the country.

On the eve of independence the state of Indian agriculture can be summed up as stagnant with deficient infrastructure, traditional technology and exploitative institutions. Nevertheless, the growth of agricultural production in India since independence has several distinguishing features. In terms of growth rates, there is a clear break with the colonial period trends in production and yields. Second, the post independence growth has two distinct phases generally termed as pre-green revolution period and post-green revolution period. Post green revolution period is marked by the adoption of new technology in few crops especially wheat and rice operating along with increased use of inputs like fertilizers and irrigation. The post green revolution period can be divided into three phases namely:

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First phase (1967-68 to 1980-81), the early green revolution phase and Second phase (1980-81 to 1990-91), the late green revolution phase, and Third phase (1991-92 to 2001-02), stagnant period.

Table 1. Share of gross domestic product and workers in the agricultural sector in India (at 1993-94 prices)

Year	Percentage share of agri. to GDP	Percentage share of agri. workers**
1950-51	59.2	69.4
1960-61	54.8	69.5
1970-71	48.1	69.7
1980-81	41.8	60.5
1990-91	34.9	59.0
2000-01*	26.2	58.4

Source: National Accounts Statistics, 2002, New Delhi, Central Statistical Organization, Ministry of Planning and Statistics. Govt. of India.

** Source: Various Population Censuses, Registrar General of India

* Provisional

Agriculture in Pre- and Post Independence Period

Colonial agriculture was characterized as stagnant using primitive technology with exploitative institutions. The Table 2 presents the growth rates of Indian agriculture in the pre-independence period from 1891 to 1946. The period of around half a century prior to independence suggests a pro longed agriculture stagnation.

Table 2. Growth performance of major crop groups in pre-independence and post independence period

Sl. no.	Major crop groups	Pre-independence period (1891-1946)			Post -independence period (1949-50 to 2001-02)		
		Area	Output	Yield	Area	Output	Yield
1.	Foodgrains	0.31	0.11	-0.18	0.35	2.48	1.78
2.	Nonfood grains	0.42	1.31	0.86	1.26	2.96	1.36
3.	All crops	0.40	0.37	0.01	0.57	2.66	1.68

The growth rate of output of all agricultural crops put together for about half century preceding independence was only 0.4 % per annum. Almost all the growth in the agricultural output was contributed by growth in area under the crops with very little or negligible

contribution by the yield per hectare. A break-up of the total agriculture output into food grains and non food grains shows diverse trends. The rate of growth for the foodgrains output was very low at 0.1 % per annum as compared to 1.31 % per annum for the non-foodgrains output. The increase in foodgrains output was very low despite some increase in the area under foodgrain crops. Obviously yield rates in this crop group were falling during this period. However, relatively higher growth rate of non-food grains crops were largely due to greater support to commercial crops from the British rulers. This was due to their major concern for the supply of agro-based raw materials to British industries. Later this was aimed at supporting the indigenous industries.

Thus on the eve of Independence the agriculture sector of India could be characterised as one which was stagnating what ever growth was there, was due to the deliberate policy of Commercialization pursued by the British. Given the fact that more than half of the domestic product was contributed by agriculture sector, lack of growth in this sector became a major obstacle to the overall economic growth of the country.

In the post independence period agriculture growth received primacy. This objective was achieved by implementing policies and programmes having bearing on agricultural production. The basic thrust of these policies was to expand and improve the irrigation input base and improve the technology. The production performance of agriculture in the post independence period was quite impressive. Over the period 1949-50 to 2001-02 the aggregate output increased at an annual growth rate of 2.48 % per annum with yield increases being the major source of growth. Food grains have an output growth not only noticeably higher than the pre-independence period but also higher than the population growth rate registered in the recent decades. It can be noted (Table 2) that the post independence record of Indian agriculture has been remarkable in comparison with the experience of many developed and developing countries in the initial stages of economic development.

Growth in the Pre- and Post Green Revolution Period

The agriculture sector's impressive growth rate in the post independence period was primarily due to the higher priority accorded to this sector by the Indian planners. The policy makers adopted a two fold strategy to rejuvenate agriculture. The first element of this strategy was to implement land reforms in order to remove the institutional bottlenecks and the second was to undertake massive investment in irrigation and other infrastructure in order to update agricultural technology.

Although the land reforms undertaken during the mid fifties did succeed to a large extent in abolishing intermediaries, however they failed to bring about an equitable distribution in land ownership as depicted in the Table 3. Nevertheless, large investments in irrigation and other infrastructure including extension and community development programmes, resulted in substantial increases in both net area sown and gross cropped area, thus increasing crop output. However the growth process of Indian agriculture was not smooth. Inspite of positive agriculture policy pursued by the state one finds the Indian economy reaching a critical stage in relation to food production towards the end of fifties. It however became increasingly clear that there being obvious limits to the extension of area, steps were needed to increase land yields. Therefore the subsequent decade witnessed the emergence of new production oriented strategy for agriculture. This strategy sought in the first instance, to achieve quick break through in production in selected favourably endowed areas especially having assured irrigation. By concentrated efforts in the form of intensive use of better methods of production these areas were expected to show higher production. This program was known as Intensive Agricultural District Programmes (IADP). New institutions were set up to extend support to developmental activities in different fields. To begin with the new strategy failed to make much impact and agricultural situation deteriorated considerably during the early sixties. Consequently country had to resort to large scale imports of food grains.

Table 3. Distribution of operational holdings - All India

Categories	No. of holdings (000' No)			Area (000' hectare)			Average size holding (ha)		
	1976-77	1980-81	1990 - 91	1976-77	1980-81	1990-91	1976-77	1980-81	1990-91
Marginal (<1 ha)	44523 (4.6)	50579 (6.6)	63389 (59.4)	17510 (10.7)	19727 (12.0)	24894 (15.0)	0.39	0.39	0.39
Small (1-2 ha)	14728 (18.1)	16102 (18.0)	20092 (18.8)	20904 (12.8)	23010 (14.0)	28827 (17.4)	1.42	1.43	1.43
Semi-medium (2-4 ha)	11666 (14.3)	12476 (14.0)	13923 (13.1)	32428 (19.8)	34533 (21.2)	38375 (23.2)	2.78	2.77	2.76
Medium (4-10 ha)	8213 (10.1)	8078 (9.0)	7580 (7.1)	49628 (30.4)	48324 (30.0)	44752 (27.1)	6.04	5.98	5.9
Large 10 & above	2439 (2.9)	2157 (2.4)	1654 (1.6)	42874 (26.2)	37174 (22.8)	28659 (17.3)	17.58	17.24	17.33
All holdings	81569 (100)	89392 (100)	106637 (100)	163344 (100)	162758 (100)	165507 (100)	2.0	1.58	1.57

Source: Agricultural Statistics at a Glance (various issues), Ministry of Agriculture, Govt. of India.

High Yielding Varieties (HYV) Seeds

The food situation in India on the eve of the introduction of new high yielding varieties was alarming. Poverty, malnutrition and starvation was quite widespread. Unemployment has increased out of proportion because of stagnation in the industrial sector. There was serious risk of breaking down of the socio-political order incase the situation did not improve. The food imports were continuously rising. The possibility of importing further was declining due to the uncertainty in world supply of foodgrains in the face of increasing demand from the food deficit regions of the world. Moreover, food prices in the world market were high and increasing, where as the economy's capacity to import was limited. The possibility of increasing production by bringing more land under cultivation through land reclamation measures and cultivation of culturable waste land's was almost exhausted. An overwhelming part of the increased production in future had to come by way of increased land productivity. Therefore in 1965 a "new strategy" for agriculture for the fourth plan was outlined. Independent of the new HYV of seeds and would have been put in operation if the former would not been available.

However it was a sheer coincidence that, by this time, after years of international research and experimentation, the new high yielding varieties of wheat and rice of short duration, short stem, fertilizer responsive became available for commercial cultivation in India. Extensive trials were undertaken in 1964-65 and 1965-66 and it was proved that these were adaptable to Indian conditions. With this agricultural development strategy went under a dramatic change. The change was from traditional to modern agriculture based on the use of non-form purchased inputs like fertilizers, pesticides, electric and diesel pumpsets, tractors and later on harvester combines.

The new technology (also known as bio-chemical technology) was introduced in India in the mid sixties for stepping up the crop output growth rates. The growth rates for the two periods i.e. 1949-50 to 1964-65, the pre-green revolution period and 1967-68 to 2001-02, post green revolution period are presented in Table 4. Agricultural growth during 1949-50 to 1964-65 was as high as 3.15 % per annum with food grains growing at 2.82 % per annum which was much below the growth rate of 3.74 % per annum registered by the non-food grains. Another noticeable feature of these very high growth rates were that wheat, registered higher growth rates due to increase in area rather than yield. On the contrary, in case of paddy growth of yields was substantially higher than that of area growth rate. Even in the case of coarse cereals as a group growth rate of yield rate were higher than the area growth. Inverse was the case of total pulses as group which grew as a consequence of area expansion only. In fact there was deceleration in the yield growth in their case.

Therefore one finds that growth in food grains production were equally shared by growth of area and yield rates. However it is clear from the Table 4 that in overall agricultural growth major contribution was made by the growth of area as compared to growth of yield. This was more glaring in case of non-foodgrain crops. The table clearly reveals that except for wheat growth rates attained in the pre-green revolution period could not be maintained in the post green revolution period despite the adoption of new technology, in some cases growth rates were considerably lower than the earlier period i.e. pre-green revolution period. This is in spite of the fact that the two drought years 65-66 and 66-67 have been dropped from the data.

The impact of the new technology on wheat production is clearly visible. Wheat production growth rate has increased from nearly 4 % per annum in the pre-green revolution period to 4.34 % per annum in the post green revolution period. However, growth rate of rice production which was around 3.5 % in the pre-green revolution period fell to around 2.8 % in the; post-green revolution period. For coarse cereals the decline in the growth rate was quite significant. The output growth rate of coarse cereals declined from 2.25 % per annum in the pre-green revolution period to a bare minimum rate of 0.54 %. Pulses also registered decline in growth rates from 1.41 to 0.81 % in the same period. The perceptible decline in the coarse cereal and pulses production is due to the drastic decline in growth of area experienced by these crops in spite of the some gains in their yield growth rates. In spite of the fall in growth rates of coarse cereal's production, foodgrains as a whole maintained a growth rate of 2.5 % in the post-green revolution period which was slightly lower as compared to 2.8 % in the pre green revolution period. Although the major source of increase in agricultural output in the pre-green revolution period was the expansion in area under the crop. Whereas, in the post-green revolution period one finds a significant contribution made by the yield rates towards the increase in the production of agricultural output which has increased from 1.36 to 2.12 % per annum. Whereas, the growth of area under foodgrains have declined from 1.35 % per annum in the pre-green revolution period to a bare 0.01 % in the post-green revolution period. It may be pointed out that the possibility of expansion of net sown area had almost exhausted by the late sixties i.e towards the beginning of green revolution. Nevertheless because of irrigation expansion and adoption of HYV seeds of short duration, there has been an increase in the gross cropped area due to increase in intensify of cropping. In fact, when one compares the early green revolution period and the later green revolution period one finds that agricultural growth has been made possible by the increasing irrigation levels in case of foodgrains as well as non-foodgrains.

Table 4. Growth performance of major crop groups in pre and post green revolution (% per annum)

Particulars	Rice	Wheat	Coarse Cereals	Cereals	Pulses	Foodgrains	Oilseeds	Fibers	Non-Foodgrains	All crops
					1949-50 to 1964-65					
Area	1.21	2.69	0.9	1.25	1.12	1.35	2.67	2.71	2.44	1.55
Production	3.5	3.98	2.25	3.21	1.41	2.82	3.2	4.56	3.74	3.15
Yield	2.25	1.27	1.23	1.77	-0.18	1.36	0.3	1.88	0.89	1.21
					1967-68 to 1980-81					
Area	0.76	2.94	-0.03	0.39	0.45	0.38	0.24	0.21	0.98	0.54
Production	2.22	5.64	0.62	2.7	-0.39	2.39	1.04	2.45	2.36	2.38
Yield	1.46	2.61	1.57	1.78	-0.66	1.54	0.77	2.06	1.2	1.43
					1980-81 to 1989-90					
Area	0.41	0.46	-1.34	-0.26	-0.09	-0.23	1.51	-1.5	1.42	0.1
Production	3.62	3.57	0.4	3.03	1.52	2.85	5.2	2.44	3.77	3.19
Yield	3.19	3.1	1.62	2.9	1.62	2.74	2.43	3.98	2.31	2.56
					1990-91 to 1999-2000					
Area	0.62	1.67	-0.54	-0.08	-0.61	-0.17	1.14	2.13	1.37	0.25
Production	1.9	3.81	1.48	2.1	0.61	1.94	2.13	1.74	2.78	2.28
Yield	1.27	2.11	-0.08	1.58	0.96	1.52	1.25	-0.48	1.04	1.31
					1967-68 to 2001-02					
Area	0.62	1.38	-1.44	-0.02	0.3	0.01	1.31	0.24	1.36	0.34
Production	2.78	4.34	0.54	2.77	0.81	2.51	3.32	2.44	3.2	2.78
Yield	2.2	2.92	1.9	2.32	0.74	2.12	1.6	2.15	1.68	1.9

Source: Agricultural Statistics at a Glance, Ministry of Agriculture, Govt. of India.

That is the growth rates for the post green revolution period were lower than the pre-green revolution period in spite of the adoption of improved technology. Even this rate became possible due to impressive growth rate of wheat which due to its high weight in the overall foodgrain production could compensate the fall experienced by other cereal and pulses crops. In fact some scholars have gone to the extent of describing green revolution as wheat revolution.

Agricultural Growth in Various Phases of Green Revolution Period

It is usual to compare the performance in the pre-green revolution period with that in the post green revolution period as a whole to gauze the impact of new technology. The beginning of eighties made a definite departure from the trends observed in the early phase of the green revolution period in several respects. There seems to be an acceleration in the growth rate of foodgrains as well as non-foodgrains output during the period 1980-81 to 1989-90 as compared to the early green revolution period that is from 1967-68 to 1980-81. Crops such as paddy, cereals as a whole, pulses and oilseeds whose growth rates in the first decade in the green revolution period had fallen much below those recorded in the pre-green revolution period have shown higher growth rates. It gives clear indications that the major inter crop imbalances in growth witnessed in the early years of the green revolution period are getting redressed to some extent in the recent period.

The comparisons of these two periods suggest that there is an increase in the growth of output of the foodgrain crops. Rice have grown at a rate of 3.62 % in the second phase of the green revolution period as compared 2.22 in the early green revolution period. However there is a perceptible decline in the growth of wheat output from 5.64 % in the early green revolution period to 3.57 %. The reason was quite simple as growth rate of area has steeply declined from 2.94 % in 1967-68 to 1980-81 only 0.46 % during the period 1980-81 to 1989-90. Nevertheless, it is noticeable that growth of yield has further increased from 2.61 to 3.10 % in the respective periods. Among the coarse cereals there is acceleration in the growth rates of Bajra, Maize and millets. On the whole one finds increase in growth rates for the total cereals from 2.61 to 3.60 %. Growth in case of total pulses as well as total foodgrains have also accelerated in the post green revolution period of 1980-81 to 1989-90.

During the nineties i.e, stagnant green revolution period (1991-92 to 2001-02) growth rate of production for both foodgrainges and non-foodgrains crops taken together as declined to 2.3 % per annum from 3.19 % per annum achieved during 1980's. The decline in the growth rate of foodgrains was sharper from 2.85 to 1.94 % pre annum. Production growth rate of paddy has declined because of perceptible decline in growth rate of productivity,

though there have been some increase in area. However, the performance of wheat was somewhat better but there was a decline in productivity growth rates. Plateauing of yield of paddy and wheat in higher productivity areas under paddy wheat system and low yield levels in central, eastern and north eastern part of the country have affected the growth of production. The decline in productivity in the nineties has been ascribed to fall in public investment in agriculture because of ever increasing subsidies. Coarse cereals productions recorded a negative growth rate mainly due to diversion of area to more remunerative crops and productivity of coarse cereals remains stagnant.

Generally a major technological improvement in a crop would be accompanied by an upward trend in both its area and yield. An analysis of area and yield for the post-green revolution periods suggests that only rice and wheat the two crops using HYV technology have positive rates of growth of area due to shift from other low productivity crops. To sum up productivity increases is the major source of impressive growth of output in the later green revolution period.

Factors Influencing Productivity

The gains in foodgrains output in the post-green revolution period have come essentially from the improved utilization of the available infrastructure and from the resulting increase in yield per hectare. Growth of foodgrains output in particular and total agricultural output in general is predominantly dependent on increasing yields rather than area. This underscores the growing importance of yield increasing technology. Clearly, current inputs like fertilizer and irrigation have become more important as a source of growth in the recent period. Although the spread of fertilizer to the new areas where the existing level of application was relatively low would have contributed to the rise in productivity per unit of fertilizer.

A major feature of the HYV technology was its package approach. New high yielding varieties seeds, fertilizers, pesticides, controlled water supply and mechanical equipment from seed drills to tractors and combine harvesters – all these agricultural inputs together formed a package. The core of this package was the miracle seed which was developed through selective breeding to be highly responsive to fertilizer input coupled with use of pesticides and herbicides, while without a controlled supply of water the full potential of the new varieties could not develop. A major feature of the new seeds is their shorter maturing period, thus leading to increase in cropping intensity. Therefore increased yield rates coupled with higher cropping intensity led to higher growth of agricultural production in the post green revolution period. The adoption of the HYV technology yielded such spectacular results that it was termed as "green revolution". Inspite of the fact that it was limited to some

cereal crops only and that too in the regions with good irrigation potential. As such its success depended on the availability of assured irrigation use of fertilizers and the HYV seeds.

Progress of HYV is indicated in the Table 5. The area under High yielding varieties of paddy and wheat increased from 0.88 and 0.54 million hectares in 1966-67 to 32.2 and 23 million hectares respectively by 1997-98. The total area under HYV crops increased from 1.88 million hectares to 76 million hectare over the same period. In 1966-67, it constituted only 2.5 % and 4.2 % to the total are under the respective crops. However in 1997-98 share of HYV area to total area under these respective crops was 67.5 % and 88 %. Total HYV area as a proportion of total foodgrains area has increased from 1.63 % in 1966-67 to 54.3 % in the year 1997-98.

Table 5. Progress in Use of Agricultural Inputs

Area under HYV (Mha)	1960-61	1970-71	1980-81	1990-91	1994-95	1997-98	2001-02
Paddy	0.89@	5.59	18.23	27.39	31.02	32.20	
Wheat	0.54@	6.48	16.10	20.97	23.25	23.00	
Total:	1.89@	15.38	43.08	64.98	71.27	76.00	
Consumption of chemical fertilizers (Lakhs tones)							
Total (N+P+K)	2.92	21.77	55.16	125.46	135.64		193.06
Per hectare (kg)	1.9	13.10	331.83	67.49	75.68		101.21

@ relates to 1966-67.

Source: Agricultural Statistics at a Glance DE&S, Ministry of Agriculture, Govt. of India (various issues)

Impressive success of this programme has resulted in phenomenal increases in the production of these cereals as well as total foodgrains during this period. Productivity of rice increased from mere 863 kgs per hectare in 1966-67 to 2,066 kgs by 2001-02 i.e. more than doubled, wheat productivity from mere 887 kgs per hectare to 2,863 kgs per hectare ie. by around 2.7 times in the same period. However the overall production of rice and wheat has risen much faster by 2.6 and 5.3 times respectively during this period because of increases in area under these crops due to relatively higher yield rates. That is to say the success story of HYV programme is limited to the two major foodgrain crops i.e. rice and wheat. Besides this it was also localized to the few states of the Indian Union and it was more true about wheat than rice. HYV was a spectacular success in case of wheat in Punjab, Haryana and

UP to be precise western U.P. where water was available in plenty. To an extent incentive price support policy of the government also played a crucial role in the increased use of new seeds.

In fact the increase in wheat output has become an important stabilizing factor in foodgrains production in the country of late wheat cultivation is spreading in the non-traditional areas such as West Bengal, Maharashtra, Assam, eastern Bihar and Orissa. In case of cultivation of HYVs of paddy there is a visible significant progress made although the pace of development is not as fast as in the case of wheat. This is due to the fact that the bulk of the crop is grown in the Kharif season which suffers from the vagaries of the monsoon, characterized by drought or floods and its vulnerability to attack by pests and diseases is very high. However in the rabi season (or winter) when rainfall is low and water management is easier the HYVs of paddy have shown much better results. As a result of the introduction of HYVs, paddy production has increased at a faster rate in the non-traditional rice growing states like Punjab, Haryana and Western Uttar Pradesh which are therefore contributing a significant proportion of the total procurement for the central pool because of limited local consumption.

Irrigation and Water Use

Water is a crucial input for plant growth. Annual precipitation is a major source of water in India. Average annual rainfall is about 1,200 mm but it is seasonal and highly uneven in its geographical distribution over the country. In some areas of the country e.g. West Rajasthan, the annual rainfall is less than 200 mm; in others e.g. Southwest India and parts of Assam it is as high as 4,000 mm. As much as 34 % of the net sown area lies in low rainfall regions i.e. with annual precipitation of less than 750 mm. Another 36 % of the area receives 750 mm to 1,150 mm. Only the remaining 30 % of the net sown area enjoy benefit of more than 1,150 mm i.e. high rainfall. In view of uncertainties in rainfall irrigation is a critical requirement not only in low and medium rainfall regions but is necessary even in high rainfall regions as a supplementary source of water in the Kharif season.

The importance of irrigation to India's agriculture cannot be over stated. Apart from its vital importance for healthy crop growth, irrigation has attained crucial significance in view of the country's expanding needs of food production. The availability of water all the year round through irrigation networks facilitates double cropping as well as reduces the impact of vagaries of nature. Given the limited opportunities for bringing the additional acreage under cultivation in future, irrigation is capable of playing a useful land augmenting role in India. Increase in agricultural production in general and foodgrains production in particular for the

growing population have to come largely through higher intensity of cropping and increased productivity per unit of land.

Irrigation is a pre-condition for the successful introduction of the new varieties even in areas known for heavy rainfall, such as the rice producing deltas of south India. The dwarf sized new varieties could not be cultivated in flooded low lying areas which have traditionally been planted with taller varieties adapted to growing with water in the fields. Therefore successful attempts were made to breed high yielding varieties which can cope with deep water conditions.

One finds that the net irrigated area as a proportion of net sown area and gross irrigated area as a proportion of gross cropped area increased from 17.56 and 17.11 % to 19.34 % and 19.90 % respectively during the period 1950-51 to 1965-66 i.e. pre-green revolution period, which further increased to 40.0 and 39.2 %, respectively, in post green revolution period. This is also reflected in the increase in the cropping intensity which have increased from 111.1 in 1950-51 to 135.1 in 1998-99 (Table 6). In the initial stages increase in net irrigated area were brought about mainly through canals and wells. According to Table 7, the percentage area irrigated by these two sources of irrigation in 1950-51 was 68.5 % which increased to 71.1 % by 1960-61. However after the mid sixties a much faster growth was registered by tube well irrigation, which is assured irrigation a prerequisite for the successful adoption of HYV technology. Over and above the quality of irrigation has improved that is it has become more assured as compared to pre-green resolution period.

Table 6. Selected categories of land use classification (million hectares)

Year	Net area sown	Net irrigated area	Percentage of NAS irrigated	Gross cropped area	Gross irrigated area	Percentage of GCA irrigated	Cropping intensity
1950-51	118.75	20.85	17.56	131.89	22.56	17.11	111.10
1955-56	129.96	22.76	17.62	147.31	25.64	17.41	114.10
1960-61	133.20	24.66	18.51	152.77	27.98	18.32	114.70
1965-66	136.20	26.34	19.34	155.28	30.90	19.90	114.00
1970-71	140.27	31.10	22.17	165.79	38.12	23.04	118.20
1980-81	140.00	38.72	27.66	172.63	49.78	28.84	123.30
1990-91	142.25	47.78	33.59	185.91	62.47	33.60	129.90
1998-99	142.60	57.03	40.00	192.62	75.56	39.20	135.10

Source: Agricultural Statistics at a Glance DE&S, Ministry of Agriculture, Govt. of India (various issues).

Table 7. Area irrigated by sources (area in thousand hectares)

Year	1950-51	1960-61	1970-71	1980-81	1990-91	1996-97
Canals	8,295	10,370	12,838	15,292	16,900	17352
	(39.8)	(42.1)	(41.3)	(39.5)	(35.7)	(31.46)
Tanks	3,613	4,561	4,112	3,182	3,245	3343
	(17.3)	(18.5)	(13.2)	(8.2)	(6.2)	(6.06)
Tube wells	(a)	135	4,461	9,531	14,211	30825
		(0.6)	(14.3)	(24.6)	(29.9)	(55.9)
Other wells	5,978	7,155	7,426	8,164	9,999	(b)
	(28.7)	(29)	(23.9)	(21.1)	(21.1)	
Other sources	2,967	2,440	2,266	2,551	3,079	3623
	(14.2)	(9.8)	(7.3)	(6.6)	(6.5)	(6.57)
Total net irrigated area	20,853	24,661	31,103	38,720	47,434	55143
	(100)	(100)	(100)	(100)	(100)	(100)

(Figures in the brackets are percentages)

(a) Included under "other wells" as separate figures were not collected during this year

(b) Other wells included in 1996-97

Source: Agricultural Statistics at a Glance DE&S, Ministry of Agriculture, Govt. of India (various issues).

Fertilizers Consumption

Rapid population increases coupled with increasing demand for land for non-agricultural purposes has lead to increasing pressure on land. Therefore the major emphasis has to be on raising the yield per acre of cropped land and on increasing cropping intensity of land used for cultivation. The net sown area is inelastic and has not increased much since 1970-71 to 1998-99. It was 140.27 million hectares in 1970-71 and increased to only 142.6 million hectares by 1998-99 i.e. has remained almost stagnant for twenty-eight years. It has already been pointed out that the new varieties are responsive to fertilizer input. Therefore with increasing dosages of fertilizer, the output from traditional varieties has grown only to a limited extent, whereas the new varieties show increasing yields up to a very high level of fertilizer input. The adequacy of the fertilizer supply is for this reason, considered by many as a major pre-condition for the success of the technology associated with the new varieties.

Traditionally the level of consumption of fertilizer in India has been very low at less than a kg per hectare. Before the green revolution period i.e., 1960-61, the consumption of fertilizer was only 0.3 million tones. However it increased to 1.90 kgs per hectare of cropped area by 1960-61 and increased to 9.40 at the time of introduction of HYVs in India. It rose to

around 32 kgs per hectare of cropped are and touched an all time high figure of around 101 kgs per hectare in the year 1998-99 (Table 8). However, consumption in India is very low in comparison other Asian countries like Rep. Korea and Japan, where the application of fertilizers per hectare is as high as 453 kg and 289 kgs respectively. Fertilizer consumption rapidly increased with the introduction of HYV's. The domestic production of fertilizer increased from 98 thousand tones in 1960-61 to 14,704 thousand tones by 2000-01. Dependence on imports has declined over the year s and they are only 2,196 thousand tones i.e. around 13.1 % of the total consumption.

Table 8. Economics of application of fertilizers on paddy and wheat in India

Particulars	1971-72	1981-82	19991-92	2001-02
Qty of paddy required to buy				
(a) 1kg of N	3.79	4.44	2.89	1.89
(b) 1kg P205-ASSP	5.45 - 6.67	4.24 - 5.31	3.37	2.95 - 3.54
DAP	3.51	5.07	3.29	2.91
Complex	4.64 - 5.60	5.84 - 7.17	3.82 - 4.67	3.08 - 5.30
(c) k20	1.68	1.89	1.23	1.34
Qty of wheat required to buy				
(a) 1kg of N	2.64	3.93	2.96	1.64
(b) 1kg of 205-ASSP	3.80 - 4.64	3.75 - 4.70	3.44	2.56 - 3.07
DAP	2.45	4.48	3.36	2.53
Complex	3.24 - 3.91	5.17 - 6.35	3.90 - 4.77	2.67 - 4.60
(c) 1kg of k20	1.17	1.67	1.26	1.16

Source: Agriculture at a Glance, 2002, Ministry of Agriculture, New Delhi

The phenomenal increase in production and productivity in agriculture since the mid sixties have been achieved through exploitation of the potential of HYVs with the help of increased use of fertilizers and assured irrigation. The pace of growth slowed down considerably during the period 1972-74 culminating in 1974-75. That was the period of energy crisis; the availability of fertilizers in the world market had shrunk; the prices had skyrocketed; ocean freight costs had galloped and profitability of fertilizer use had reached a low point. The steep rise in the price of chemical fertilizers had a dampening effect on the use of fertilizers. In northern India where selling fertilizers was never a problem, sales met with resistant from the peasants. The situation changed due to corrective action taken by the government, and supported by the industry and facilitated by the distinct improvement in the world situation. The Table 8 clearly shows that the fertilizer prices have continuously declined since 1980s in terms of rice and wheat output prices.

Massive increase in fertilizer consumption would require a matching effort to strengthen the production and marketing infrastructure so as to make the right type of fertilizer available to the farmer at right place, at the right time and at the right price. It would also need a matching effort in providing strong extension support and making available other inputs such as irrigation water, credit and quality seeds to the farmers.

Investment in Agricultural Sector

Investment in the economy in the agricultural sector picked up with the introduction of new technology. Table 9 shows that during the pre green revolution period i.e. 1960-61 to 1969-70 growth of capital formation in the agricultural sector was 3.65 % per annum. The public sector investment was growing at 2 % per annum and the private sector at a rate of 5 % per annum. It may be mentioned that the share of private sector was higher in the capital formation in the agricultural sector as compared to public sector. However, in the post-green revolution period the growth of capital formation picked up and grew at 5.38 % per annum due to public sector participating more rigorously and growing at a higher rate of 6.41 % per annum and even higher than private sector. Then, there is a steep decline in the following periods as far as public sector investments are concerned. This has a bearing on the productivity in the agricultural sector which has started stagnating or declining. On the contrary growth rate of private sector picked up in the following periods i.e., 80 and 90. This happened because of wide spread mechanization.

Table 9. Growth in gross capital formation in agriculture: 1960-61 to 2001-02

Period	Public sector GCF	Private sector GCF	Total GCF
1960-61 to 1969-70	2.54	9.81	6.67
1970-71 to 1979-80	9.60	7.90	8.61
1980-81 to 1989-90	-4.38	2.08	-0.86
1990-91 to 2001-02	-0.66	3.70	2.86
1960-61 to 2001-02	1.47	3.55	2.85

Mechanization is induced by the secular tendency for the biological sources of energy to become costlier as compared to mechanical sources. This is due in part to the labor saving bias of the technological change as well as increasing ease with which capital can be substituted for labor in agriculture. Further with the rise in incomes of farmers, the desires to reduce the drudgery of manual work assert itself. It may even raise the participation rate among those who could afford to abstain from the drudgery of manual work. Further, as Hanumantha Rao has argued labor in the sense of effective energy or efficiency units can't

be abundant when food is in short supply and the cost of labor can rise despite the growth of population. Besides economic compulsions, the presence of mechanical sources of energy particularly tractors adds to the prestige (status) of farmers.

The accompanying Table 10 shows the degree of mechanization of Indian agriculture since 1966. The table shows a very low degree of mechanization in the year 1966 i.e. at the time of adoption of new technology. Since then the pace of mechanization gathered momentum as is evident from the increase in the number of oil engines with pumping sets and electric pumping sets for irrigation, four wheeled tractors and threshers for wheat, paddy and other crops etc. The number of electrical pump sets has increased from 415 thousand in 1966 to 4,518 thousand by 1987 i.e. increased ten times (Table 10).

Table 10. No. of selected agricultural implements and machinery (in thousands)

Items	1966	1987	1992
1. Ploughs (wooden & iron)	43,446	51,888	395,815
2. Diesal engine (pump sets)	471	116,666	45,774
3. Electric pump used for irrigation	415	4,518	64,035
4. Tractors used for agriculture	54	738	12,218
5. Threshers	349	515	
6. Sugarcane crushers	695	718	5,861
7. Animal carts	12,697	14,350	133,860

Source: Livestock Census 1966, 1987, and 1992

Many factors have contributed to the growth of tractor use in the country with the introduction of the new varieties. On the supply side, the HYV seeds have been launched with an accompanying generous credit policy which has made the purchase of agricultural machinery easier. However, easy financing can't by itself explain the shift to tractor ownership, since according to available estimates, until 1970 only 10 % of the tractors were purchased with the institutional loans.

Most of the money for their purchase came from private sources, part of it from the increased profits accruing to the large farmers from the cultivation of new varieties. The food situation in India on the eve of introduction of HYV was alarming. Even the possibility of importing foodgrains had exhausted due to the uncertainty in word supply of foodgrains especially in the face of increasing demand from food deficit regions of the world. On the other end possibility of increasing production by expansion of area had exhausted and the only option left was to increase productivity. Exactly at that time newly developed improved

varieties of seeds of wheat and rice which were more responsive to fertilizer and irrigation became available.

This led to impressive growth of production of wheat and rice output due to spectacular increase in the productivities of these crops. Expansion of area under high yielding varieties of seeds was matched by the increasing application of technical inputs. The adequacy of the fertilizer supply was a major pre-condition for the success of this technology. Another crucial input was the assured irrigation. The availability of water all the year round through the irrigation networks initially and tube well irrigation later on not only helped in increasing the productivities of the HYV crops but also resulted in increasing cropping intensity to increase the per unit productivity of land. Although mechanization especially tractors and combine harvesters were instrumental in replacing both bullock power and human labor nevertheless they had an advantage in saving time by enabling certain agricultural operations to be completed within given time, thus leading to higher intensity of cropping on the one hand and increasing productivity by minimizing losses on the other.

Impact of Technology

A technical change of such a magnitude has for reaching implications for the economy and the people and institutions governing them. Some of these issues have been discussed here. The most hotly debated issue about green revolution is the growing income inequalities between different regions and different classes of farmers. Since the success of new technology depended greatly on the adequate provision of water, its beneficial effects were mainly concentrated in the irrigated regions of the country. Therefore in the early phase of green revolution regional disparities were high. It was because of the inability of the poorly endowed regions to adopt new technology on large scale. Regions poorly endowed with suitable Soil, climatic and irrigation facilities of these have failed to achieve the same level of output and income as that of better-endowed regions.

However experience in the later period reveals trends, which were typical of a diffusion process. These trends were: the spread of green revolution to new areas, the increasing adoption of new technology by small, farmers, the decline in relative prices of food grains, and, rise in the real wages in agriculture in the less developed regions where technology is spreading.

Although it is a general understanding that any land saving technological charges would displace labor did not come true. The land saving technological charges in labor abundant economy like India has resulted in greater absorption in agriculture. Many studies showed that green revolution did increase labor absorption in the farm sector. In fact the

demand for labor increased in the green revolution regions prominent among them Punjab followed by Haryana. The rise in demand for labor in Punjab was so much that about a million workers use to migrate each year from the agriculturally backward regions of eastern up and Bhihar for rice transplanting and harvesting of paddy and wheat in the state.

The short-duration HYVs of seeds coupled with increase in irrigation facilities resulted in increase in cropping intensity and led to increase in labor use. In practice, however, Because of the profitability of intensive farming involving the use of a large quantity of water and fertilizers per unit of land, there was an incentive for increasing cropping intensity, leading to increase in output per unit of land. However, until recently the impact of new technology and the expansion of tube well irrigation was not significant in the regions where labor was plentiful. A major proportion of area continues to be rained and may explain why the rise in cropping intensity at macro-level has fallen short of the plan expectations in the post-green revolution period.

Growth of agriculture has been uneven because of heterogeneity of soil and climatic conditions not only across the regions but in a region as well. There fore the absorption of labor has to be guided by these conditions and the nature of crops grown and input as well as availability of institutional credit for the less developed regions. Some scholars have mentioned that uneven regional growth was mainly responsible for the low absorption of labor within agriculture. In a large number of states, especially in those regions where there was an abundant availability of labor, the growth of output was too slow to generate adequate employment opportunities. In high-growth regions labor was not plentiful and wage rates were high. Which led to movement of labor from low growth backward regions to high growth developed regions. The sudden rise in the demand for labor in these areas also induced mechanization and labor-saving practices in general. The improved performance of the eastern states in respect of food grains output, particularly rice, during the eighties, might lead one to think that these regional disparities have stared narrowing down in the recent years.

However, the inter-state disparities in agricultural wages started declining since the mid-seventies (Jose, 1988). The decline in disparities in real wages is even more significant. This is because the decline in the relative prices of food grains had a greater impact on the purchasing power of wage-earners in low-wage areas. For example, the disparities in real wages in agriculture between the Punjab on the one hand, and Bihar on the other, started declining from eighties. The real wages in the Punjab having risen significantly in the early phase of the green revolution virtually stagnated after the mid-seventies for some years and have continuously increased up 1993-94 and then moderately declined.

Whereas the real wages in Bihar started rising slowly and then remained almost stagnant but were higher than Karnataka, where the impact of technology was almost missing. Nevertheless in eighties and nineties the inter-regional variations were almost constant as is depicted by the coefficient of variation (CV) in Table 11. The causes for the constancy of inter-state disparities in real wages are: due to the out migration of labor form the less developed low wage regions to the high-wage areas the mechanization of agricultural operations in the developed regions having a depressing effect on rising wages, the decline in the relative prices of food grains; the increase in employment generated in the less developed regions under the poverty alleviation programs; and the recent decline in agricultural growth in these regions. An encouraging consequence of these developments is that the disparity between the male-female wage rates has also, started decline in several states. The use of new technology may have improved the bargaining power of female labor for operations such as transplanting and interculturing on account of the rise in seasonal demand for such labor.

In the initial stages of technological change, large farmers, owing to their better access to knowledge and resources and because of their capacity to bear risks, took the lead in the use of high-yielding varieties of seeds coupled with fertilizers thus increasing output on their farms faster than on small farms. This resulted; in weakening or in some places even the disappearance of the traditionally-observed inverse relationship between farm size and output per hectare, which prompted some analysts to assert that in the context of new technology large farmers are as efficient as, and even more efficient than, small farmers However this fact could no be substantiated by not be an studies conducted even in the late eighties. In fact, authors own study based on 1974-75 data of Haryana and Orissa study based on 1989-90 data clearly shows the inverse relationship between farm size & Productivity. (see Table 12 & 13).

However, such observations and studies reflected that higher output per acre of net sown area among small farms was achieved not only through higher cropping intensities involving the greater use of labor as well as by stepping up significantly the yield per hectare, of certain individual crops such as rice and wheat, due to intensification of inputs like fertilizer and irrigation. In so far as cropping intensity among small farms continued to be higher than among the large farms.

Table 11. Real wage rates (Rs.) of male agricultural laborers (field man, field labor and/ploughman) across different states for the period 1980-81 to 1996-97

Year	AP	Bihar	Gujarat	Haryana	Karnataka	Kerala	MP	Maharastra	Orissa	Punjab	Rajasthan	Tamil Nadu	UP	WB	CV
1980-81	1.69	1.36	1.49	2.87	1.51	2.90	1.10	1.29	1.08	2.69	2.02	1.44	1.44	1.74	35.56
1981-82	1.66	1.53	1.98	3.12	1.41	3.08	1.17	1.26	1.06	2.66	2.24	1.53	1.82	1.66	35.91
1982-83	1.91	1.51	2.64	3.38	1.46	3.04	1.41	1.43	1.00	2.83	3.05	1.45	1.74	1.58	38.48
1983-84	2.11	1.57	2.75	3.59	1.32	2.62	1.55	1.53	1.18	3.06	3.00	1.53	1.79	1.60	36.83
1984-85	2.26	1.81	2.90	3.51	1.33	3.01	1.66	2.05	1.39	3.30	2.09	1.68	1.92	1.92	31.79
1985-86	2.39	1.90	2.73	3.43	1.74	3.32	1.64	2.09	1.40	3.31	2.43	1.72	1.98	2.25	28.82
1986-87	2.52	2.04	2.78	3.75	1.63	3.44	1.82	1.89	1.46	3.56	2.96	1.73	2.18	3 .007	32.14
1987-88	2.48	1.94	2.36	3.47	1.59	3.53	1.76	1.89	1.40	3.60	3.51	1.66	2.00	2.95	33.46
1988-89	2.37	2.12	2.67	3.50	1.82	3.49	1.73	1.90	1.46	3.61	3.00	1.73	2.96	3.36	30.14
1989-90	2.78	2.16	2.69	3.88	1.98	3.47	1.90	2.35	1.59	3.85	2.83	1.92	2.31	3.27	28.13
1990-91	2.80	2.24	2.57	3.78	1.92	3.65	2.03	2.51	1.75	3.99	2.85	1.97	2.22	3.07	27.30
1991-92	2.48	2.14	2.46	4.00	1.67	3.80	1.95	2.14	1.68	4.13	3.02	1.87	2.25	2.88	32.39
1992-93	2.52	2.01	2.65	4.49	1.43	4.17	2.19	2.16	1.86	4.31	2.91	2.12	2.42	3.58	35.39
1993-94	2.74	2.10	2.73	4.26	2.02	4.05	2.11	2.71	1.86	4.38	2.69	2.37	2.25	3.35	30.15
1994-95	2.82	2.19	2.76	4.28	1.70	4.27	2.14	2.69	1.79	4.33	2.72	2.39	2.20	3.17	31.70
1995-96	2.76	2.25	2.71	4.41	1.55	5.23	2.25	2.31	1.75	4.22	3.42	2.51	2.51	3.14	36.05
1996-97	2.81	2.08	2.99	4.47	1.88	5.53	2.28	2.68	1.80	4.03	3.53	2.67	2.36	3.52	35.11
Growth. Rate(%)	2.97	2.67	1.77	2.40	1.50	3.66	4.03	4.35	3.82	3.16	1.93	3.71	2.53	5.23	-

Note: The real wage rate for a state in a specific year has been calculated by deflating the state's nominal wage rate by the corresponding CPIAL of that state in that specific year

Many studies discovered that although the rate of adoption was higher among the large farmers but the intensity of adoption was higher on the smaller farmers as well as proportion of area irrigated which kept the inverse relationship intact (Sharma, 1992). There may be a few studies talking about the mechanical device displacing labor. However their use was necessitated due to shortage and uncertain supply of labor. Therefore it did not have of an adverse effect on the employment and income of hired labor whose absorption has been increasing. However, it did have a depressing effect on the rising wage-rates which almost stagnated. Since such a technology is size-neutral, though not resource-neutral, there was no basis for the emergence of the phenomenon of increasing returns to scale, in the strict sense of the term.

The nationalization of major commercial banks in the mid-seventies and the development of other formal institutions for the supply of rural credit, made the credit available to small and marginal farmers at lower rates of interest, improved the small farmers' access to modern inputs significantly (Desai, 1988). The use of new seed-fertilizer technology among small farms caught up with that of large farms. Small farmers have advantage in respect of cropping intensity, the inverse relationship between farm size and output per net operated area did not disappear, labor input per acre continued to decline sharply with the increase in size of holding which was one of the causes for the inverse relationship. Nevertheless their dependence on the informal institutions for credit continues to be substantially greater than large farmers putting them at a disadvantage.

A comprehensive field study conducted in Haryana, for the year 1974-75 with a large sample of 3,412 households spreading over the whole state which was one of the early adopter of the green revolution clearly brings out that the impact of green revolution was higher among the small farmers as for as output per acre is concerned. Although there was a direct relationship between the rate of adoption and farm size, nevertheless intensity of adoption is higher among the small farmers as compared to large farms i.e. having an inverse relationship. A major proportion of the area under HYV was initially claimed by wheat follower by paddy by the adopter households. However Paddy is localized in a region of the state mainly because of adequate and assured supply of water. Wheat is quite wide spread over, as it requires less intensive irrigation. Study further finds that output of adopter households was significantly higher than the non-adopter households and inversely related with the farm size (Table 12). However, in absolute terms the gaps between the lowest and highest farm size groups have been induced mainly by the skewed land distribution. Study further shows that share of gross irrigated area as well as intensity of cropping are higher for the adopters as compared to non-adopters and is inversely related to farm size. Similarly per acre fertilizer input is also higher for the adopters and is inversely related to farm size.

It is interesting, however that small farms use their cropped area relatively more intensively than large farms. However, the advantages of large farms to the rate of use of inputs including tube well irrigation is outweighed by the advantage that small farms have by way of higher cropping intensity. The study brings out the relationship between farm size and cropping intensity to be negative and statistically significant. The authors have, therefore, studied the relationship between farm size and value of output per acre of net operated area and found this to be negative and statistically significant. It is thus clear that the slight edge that large farmers had in regard to the use of modern inputs was more than counter balanced by the small farmers' advantage due to availability of family labor.

The same findings were reconfirmed by the 1989-90 data of Orissa which again showed that small and marginal farmers not only have a higher intensity of cultivation involving a greater use of labor, irrigation, cropping intensity, and use of organic manures but also show a higher rate of input use involving cash outlays such as for chemical fertilizers. In fact, the per acre use of bio-chemical inputs in HYV is more than double of that in traditional rice for all categories of farm household in the state. It is also observed that all the farmers use more labor per unit of land in HYV than in traditional varieties. The demand for hired labor increases substantially under the new variety. It is because of the agriculture in general and new technology in particular has time bound agricultural operations which increase the demand per labor at that point of time. Even the small farmers are compelled to depend on hired labor to complete the specific agricultural operations in time, though they have surplus labor during other times of the year. Further shows that the availability of 'cheap' family labor and the managerial and supervisory advantages of small size may account for their better performance, particularly because there are some complementarities between the use of biochemical inputs and human labor (Sharma and Swain, 1995).

To sum up the above analysis shows those small and marginal farms, though still lagging behind large farms in the adoption of new technology, have been able to bridge this gap significantly over the last two decades. Their advantages in regard to "cheap" labor and managerial efficiency still persist, resulting in higher levels of irrigation and cropping intensity. On balance, therefore, the inverse relationship between farm size and productivity per unit of net operated area persists even now. Further, since labor input per acre has declined among the large farms, due to the use of tractors and harvest combines had a depressing impact on the employment and income of the wage labor.

Table 12. Input and output per acre according to farm size in Haryana, 1974-75.

Particulars	Marginal (0-2.49)	Small (2.50-4.99)	L-middle (5.00-7.49)	U-middle (7.50-12.49)	Big (12.50-24.99)	Very big (25 & above)	All
Adopeters							
Sample size	191	377	449	494	306	90	1907
Net operated area (acres)	1.63	3.52	5.94	9.66	16.7	32.85	8.99
% Irrigated area	89.23	81.45	73.75	72.08	68.35	65.9	75.21
Cropping intensity	1.87	1.76	1.63	1.59	1.51	1.47	1.66
Family size	6.38	6.54	7.42	7.87	9.11	9.69	7.71
Per acre gross output (Rs.)	1,508.47	1,471.43	1,376.53	1,303.76	1,196.07	1,186.26	1,280.95
Per acre cost (Rs.)	613.14	585.03	492.71	429.77	374.21	383.21	430.32
Per acre fertilizers manure (Rs.)	99.96	97.13	75.01	73.42	66.91	72.73	73.93
Non-adopeters							
Sample size	223	30	381	341	164	36	1505
Net operated area (acres)	1.6	3.5	5.9	9.7	16.4	29.8	7.2
% Irrigated area	53.0	53.1	57.3	50.2	45.0	44.7	52.4
Cropping intensity	1.6	1.6	1.5	1.5	1.3	1.3	1.5
Family size	6.3	6.6	7.3	7.9	9.1	9.1	7.4
Per acre gross output (Rs.)	979.6	446.9	957.5	900.6	788.8	791.5	884.0
Per acre cost (Rs.)	413.4	394.9	348.6	302.5	221.5	204.6	296.6
Per acre fertilizers manure (Rs.)	31.6	31.4	30.0	25.5	20.4	19.3	25.4
Adoption gains (1974-75)							
Percentage gains	62.15	55.41	42.23	44.75	51.62	49.88	44.9
Rate of adoption	46.14	51.15	54.1	59.16	65.11	71.43	55
Intensity of adoption	63.58	53.5	45.62	42.73	40.16	42.22	43.77

Source: Sharma, R.K. (1992).

Despite severe hardships for the migrant labor and their exploitation, social tensions are not acute and, by and large, there is an outward appearance of peaceful transformation in the areas of the green revolution. Apart from the availability of unorganized and dependent migrant labor this apparent harmony is also explained by the prevailing land-tenure systems. The initial conditions in the areas of the green revolution were generally favorable as they were characterized by the Ryotwari system of tenure and not the Zamindari or other semi-feudal systems. However, the major reason for the absence of these tensions were the quantum of work generated in the rural areas which could not been handled by the local labor. Due to enormous increase in output in the states like Punjab lots of high wage jobs were created in the new Mandi towns which absorbed the local labor. Even in the rural areas local labor was offered higher wage jobs in their own states. Also, despite the hardships and exploitation, the income of the migrant labor was much higher than what they would have been able to earn in their own states.

It is interesting to observe that despite the existence of such a large reservoir of labor force, the rate of mechanization was higher in the process of the green revolution. As already mentioned this was due to the fact that agricultural operations are to be competed with in a short span of time and to be on safer side farmers made use of the machines without creating any unemployment among the local labor. It might have slowed down the speed of migration to these areas. However, it does have a depressing effect on the wage rates to the extent that they did not rise further at the same rate.

The small farmers' capacity to survive and even to use technology successfully is reflected in the social relations in rural areas. The conflict of interest one witnesses, on account of the green revolution, is not much between the sharecropper and the landlord or between the small and the large farmers. Although the transformation appears, by and large, peaceful despite being painful in the green-revolution areas, it has repercussions in the backward areas, particularly those characterized by semi-feudal relations. In the process of migration, the labor has become more skilful, enterprising, and has considerably improved its staying power on account of the rise in its income. The Proportion of migration-prone labor is quite high in certain backward areas. As a result of the rise in staying power and supply price of labor, the real wages have started rising in such areas between the early seventies and the late eighties, so that the wage disparity between the developed and the less developed areas has not been increasing further (Table 13). The male-female disparity in wage rate is also coming down.

Table13. Per acre output, employment and expenditure on bio-chemical inputs in Orissa farm size (in acre)

Particulars	Marginal (up to 2.5)	Small (2.5-5.0)	Medium (5.0-10.0)	Large (10 & above)	All
Yield rate per acre of cropped area					
Desi	7.10	6.21	6.91	6.18	6.63
HYV	14.90	16.18	14.56	13.98	15.07
% change	109.85	160.54	110.70	126.21	127.30
Per acre use of human labor days					
Desi	59.11	50.02	45.51	33.32	50.37
HYV	89.90	81.82	74.22	73.05	86.44
% change	52.08	63.57	63.08	119.23	71.61
Per acre expenditure on bio-chemical					
Desi	373.73	338.97	317.91	313.63	344.29
HYV	746.48	723.40	748.49	703.83	732.63
% change	99.73	113.41	135.44	129.41	112.79

There are certain other features of the green revolution, apart from the rise in wages, which have directly benefited the poor. Despite mechanization, agriculture is still more labor-intensive than many of the industrial activities and, what is more, it provides employment to the poorest of poor. Because of competition and also because there is an early limit to the demand for essential commodities like foodgrains, the green revolution has brought about a decline in the relative prices of foodgrains such as wheat and rice. This is how the benefits from the rise in productivity on account of the green revolution have been passed on to the consumers. This is also reflected in the declining poverty ratios (Table 14). The Poorer sections, who spend a large proportion of their budget on foodgrains, have been benefited relatively more than the well-to-do from the decline in the relative prices.

In so far as large farmers have resumed self-cultivation from sharecroppers because of the profitably of new technology, it has led to lower labor absorption and reduced incomes of erstwhile tenants. However, in quite a few places, cost sharing on new input s between the landowners and sharecroppers has become popular resulting in the sharing of benefits from new technology by the landowners as well as the tenants (Srivastava, 2001). Though share crop tenancy is predominant in the state of Orissa, there is a marked shift from share crop tenancy to fixed rent tenancy in the developed villages. One also observers that fixed rent tenancy is positively related to farm size showing that bigger size farms prefer to operate under fixed rent arrangements. There are three important factors which determine the crop

shares between the tenants and the landlords. The quality of the soil, pattern of cost sharing between the lesser and the lessee and the adoption of HYV rice. Impact of the new technology on the inter-locking of the land-lease market has also been studied in Orissa. It is found that more tenants in the underdeveloped villages are operating in the inter-locked market as compared to developed villages where inter-locking is substantially less. Underdeveloped villages, the land credit inter-locking is quite common while in the developed villages, land-labor inter-locking is relatively higher. Technological progress seems to have made a perceptible-dent on rural poverty. The proportion of population below the poverty line is lower in developed areas using HYV technology as compared to in underdeveloped areas. However the most important limitation of new technology is that it tends to accentuate regional disparities. Therefore, in the near future, the new technology should be extended, with effective policy measures, to those areas which were deprived of it in the past.

Table 14. Rural poverty ratio at the state level (Percentage)

STATES	1973-74	1993-94	1999-00
Andhra Pradesh	48.41	15.92	11.05
Assam	52.67	45.01	40.04
Bihar	62.99	58.21	44.30
Gujarat	46.35	22.18	13.17
Haryana	34.23	28.02	8.27
Himachal	27.42	30.34	7.94
J & K	45.51	30.34	3.97
Karnataka	55.14	29.88	17.38
Kerala	59.19	25.76	9.38
M.P.	62.66	40.64	37.06
Maharastra	57.71	37.93	23.72
Orissa	67.28	49.72	48.01
Punjab	28.21	11.95	6.35
Rajasthan	44.76	26.46	13.74
Tamil Nadu	57.43	32.48	20.55
U.P.	56.33	42.28	31.22
West Bengal	73.16	40.8	31.85
All India	56.44	37.27	27.09

Source: Economic Survey 2001-2002

A technology that is essentially natural to scale has been introduces in an environment in which the economic, Social and political institutions have varied widely with respect to their regularity. One can sum up the debate with "Wolf ladejinsky's view" when all is said and done, it is not the fault of the new technology that the credit service doesn't serve those for whom it was originally intended; that the extension service is not living up to expectations; that the panchayats are essentially political rather than development bodies; that security of tenure is a luxury of the few; that rental, are exorbitant; that ceilings on land are merely notational; that for a grater part tenure 12, legislation is deliberately miscarried or wage are hardly sufficiently to keep soul and body together (Binswanger and Rutton, 1978).

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An Integrated Approach towards Sustainable Agricultural Development

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Introduction

The Republic of Mauritius is an island country of 1,865 km^2 in the southwestern Indian Ocean, some 1,800 km from the East Coast of Africa at approximately latitude 20ºS and longitude 57ºE. Agriculture is the third-largest sector contributing 7% of the GDP; 48% of the land is under cultivation, with sugarcane as the main crop (45%) followed by food crops (7%). Annual vegetable production is around 100,000 tons on 6,800 ha.

Technology transfer and research is the responsibility of the Agricultural Research and Extension Unit, an institution which operates under the Ministry of Agriculture. It provides extension support to some 10,000 food crop and fruit tree growers through an extension network disseminated throughout the country. The extension system used is basically a training and visitation system. A participatory approach is ensured through technology review meetings between farmers and research and extension services, as well as through needs assessment workshops and through planters' liaison meetings.

This country's paper presented herewith in the context of this workshop is based on an irrigation project currently being undertaken in the northern region of the island, which is funded by the European Union (EU) and the Government of Mauritius (GOM). In this paper, we attempt to provide participants with insights into the use of an integrated approach for technology transfer with sustainable agricultural development. It highlights how technology transfer need not be limited to technical fields only but also that it can be extended to other fields, such as management and group capacity.

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Northern Plains Irrigation Project (NPIP): Diversification Component

Project Background

This project is related to the Government's general program of strengthening the agricultural sector through improving the irrigation infrastructure. One aspect of the project is the diversification component whose objective is to increase the total area under food crop cultivation to 700 ha. For the purpose of this workshop on technology transfer, this paper addresses only the diversification component.

The project area is located on the Northern Plains of Mauritius, one of the driest regions of the island, with an annual rainfall of 1,500 mm. This region has a relatively large concentration of small sugarcane and/or food crop (both vegetable and fruit) growers. It contributes 25% to national food crop production and some 20% to sugarcane production. However, due to a severe lack of irrigation facilities to date, food crop production in the Northern Plains has yet to attain its full potential. Research has shown that given the good soil fertility in the North, with adequate irrigation and de-rocking works, the agricultural potential of the region, in terms of area under cultivation and crop yield, can be increased.

Beneficiaries

In the project area, the majority of the beneficiaries vary among categories as well as in terms of their professions and opportunities available, which are summarized below.

- The beneficiaries mostly include smallholder operators who own a cultivable plot ranging from 0.4 to 2.0 ha, with an average size of less than 1 ha. Only some 10% of planters have farm sizes larger than 2.0 ha. Approximately 40% of planters are part-time producers.
- The overall educational level of these planters is low, with two-thirds having completed only a primary education.
- Their average annual income is about one-third of the national per capita income. This group is constrained by vulnerability to adverse climatic conditions and a lack of irrigation and operating capital needed for crop production. The net result is low productivity and unstable family incomes.
- Agricultural production is predominantly a male occupation, with approximately only 20% of planters being women. Family labor is an important agricultural input, although it is primarily utilized on an occasional basis.

The main crops grown in the area are tomatoes, potatoes, and chilies. Other crops, such as okra, eggplant, cucumber, and pumpkin, are also grown on a relatively smaller acreage depending on the season. An additional 8 ha is under fruit production, mainly litchis and citrus.

Interventions

In 1997, the GOM and the European Commission signed a financing agreement for the NPIP. The financial agreement was approved on the condition that 20% of the newly irrigated area, i.e., 700 ha, would be permanently taken out of sugarcane production and devoted to food crop and fruit tree cultivation. In this respect, EU funds are being provided for technical assistance to support the executing agency, the Agricultural Research and Extension Unit (AREU). Additional EU funds are also available for equipment, related field activities, and capacity building to enhance support provided by AREU's extension and research activities to the planting community in its endeavor to diversify its agricultural production base.

The main objective of the diversification component is to support the Government's comprehensive diversification strategy to stimulate diversified and sustainable economic development for small and low-income planters. This will be achieved by the following measures.

1) Improving the income of small planters by enabling them to use more cost-effective systems (such as irrigated crop production) and reap the benefits of higher yields and stable incomes.

2) Diversifying into non-sugar crops such as vegetables and fruits, with a view to reducing dependence on imported food items and mitigate the possible negative impact of losses of revenue from sugar exports arising from world trade liberalization. Under the ACP-EU sugar protocol, Mauritius has a guaranteed market for some 500,000 tons of sugar at preferential sugar prices.

3) Strengthening their ability to compete in the local and export markets both to maximize profits and meet evolving consumer demands.

Diversification Component: Work Plan

A. Diversification results as proposed by the EU International Technical Assistance Team

The following results are expected by the end of the project life:

Result DR1 – Farmers' diversification planning and management capacity strengthened;
Result DR2 – Delivery and extent of agricultural support services enhanced; and
Result DR3 – Market information system implemented and operational.*

* Although not directly related to technology transfer, this aspect has been included in this paper to show its relationship to an integrated approach to technology transfer. Improving production should be accompanied by market opportunities.

(1). *DR1 – Farmers' diversification planning and management capacity strengthened*

This result will be achieved through an integrated and dynamic process of motivation and training, based on the participatory and demand-driven approach with a strong accompanying support from the Project Implementation Unit team. Diversification choices will be based on planters' needs and/or demands as they evolve during the project life.

Team spirit will be created and nurtured among farmers, through group formation, while entrepreneur's skills will be developed through training in farm management. Moreover, financial and technical assistance will be provided to specific groups of beneficiary farmers to support particular diversification pilot and micro-projects, which will serve as demonstration units and eventually pave the way for other farmers to follow.

(2). *DR2 – Delivery and extension of agricultural support services enhanced*

AREU support services will be enhanced to beneficiary farmers through the provision of economic information (typical project profiles, and feasibility and market studies) on specific crops introduced or to be promoted in project areas.

AREU support services will also be improved through: (a) strengthening the applied research capacity and streamlining research programs; (b) upgrading training and extension facilities at Mapou; and (c) training research and extension staff in participatory, training, and extension (PT&E) methods and specialized technical fields.

(3). *DR3 – Market information system implemented and operational*

A market information system (MIS) providing horticultural information (such as estimates of harvested areas, areas under new crops, level of production, and market prices for fruits and vegetables) will be set up, covering the entire island. This information will be

made available to domestic operators and to the institutions responsible for agricultural/market development. Different levels and frequencies of analysis, media, and formats will be used according to the nature of operators (producers, traders/wholesalers, retailers, processors, and exporters) and the institutions involved.

Moreover, a trade facility for trading horticultural products and a database for agricultural production inputs will be implemented. In parallel, market research will be conducted on the domestic and international horticultural markets.

B. Diversification activities as proposed by the EU international technical assistance team

(1). *DR1 – Farmers' diversification planning and management capacity strengthened*

- Forming and developing farmers groups;
- Developing farmers' entrepreneurial attitudes;
- Participating in production development; and
- Participating in services development.

(2). *DR2 – Delivery and extension of agricultural support services enhanced*

- Developing AREU agro-economic support services;
- Strengthening AREU applied research capacity;
- Strengthening AREU training, extension, and services delivery systems;
- Training research and extension staff; and
- Increasing the availability of seed, planting material, and other agricultural inputs.

(3). *DR3 – Market information system (MIS) implemented and operational*

- Assessing MIS needs;
- Implementing an MIS system;
- Developing the MIS; and
- Conducting market research.

Project Inception Phase

The project began in March 2003 with a 2-day project implementation workshop where stakeholders comprising support institutions and planters' association were invited to discuss and validate the consultant's logical framework. This was followed by a baseline survey (questionnaire type and focus groups) where farmers' attitudes to diversification and constraints were assessed.

Baseline survey conducted among farmers during the inception phase

Some of the main constraints identified are as follows:

- Aversion to risks and a lack of insurance;
- Market prospects;
- Lack of financing;
- Inadequate know-how;
- Adverse climatic conditions due to cyclones;
- Reluctance to form groups; and
- Costs and availability of labor.

DR1- Farmers' diversification planning and management capacity strengthened by the formation and development of farmers groups

(1) Mobilization campaign

Village meetings were organized to mobilize and sensitize farmers to the project objectives and what opportunities they would enjoy under the project in terms of technical and financial support. This was the first step in creating awareness among planters regarding diversification. Furthermore, project brochures and posters were produced as part of the mobilization campaign complemented with press and radio communiqués.

(2) Diversification planning workshop

Two workshops were carried out to (a) identify the farmers' areas of interest, (b) brainstorm on the viability/feasibility of their proposals, (c) assess the support required by the farmers, and (d) inform planters of the support to be provided under the project. Some 200 planters attended the two workshops, and 150 confirmed their participation in the project.

(3) Formation of farmers' groups

Because of the mobilization campaign, some 110 farmers formed nine Technology Development Groups (TDGs) which focused on the production of tomatoes (two groups), ornamentals, hydroponics, onions, potatoes, spices/herbs, creepers, and fruits.

With respect to Service Development Workgroups (SDWs) whose objectives are to provide support services to beneficiaries of the project as well as other planters in the vicinity of the project area, only one such group was formed: the SDW on mechanization. Another SDW on marketing is now in formation. An SDW on irrigation did not materialize, as planters were not interested in this type of activity. These groups were formed voluntarily by planters in the TDGs.

Group members were invited to participate in specific group meetings during which key issues such as mandates and objectives of the group and the roles and responsibilities of each member were discussed in participation with PIU staff.

Basic items (books, files, etc.) will be provided to TDGs and SDWs to assist them in acquiring/managing common assets. Personalized items, such as caps and satchels, will also be provided to all members of the group to create a group spirit.

Capacity building of farmers' groups in group formation

Four training modules (group development, administrative and financial management, advocacy and governance, and delivery of services) were conducted for two groups of 15 participants (selected from the different groups) with duration of 3.5 days sessions. Course modules were adapted according to the needs of the groups based on discussions held during group meetings. The training consisted of presentations, lectures, case studies, individual and group exercises, and individual and group assignments.

Development of farmers' entrepreneurial attitudes

Three training modules (production management, financial management, and market research and marketing skills) will be conducted for groups of 15-20 participants over 5.5 days sessions.

Participatory production development

(1) Technical assistance to TDGs

The project assists different TDGs in developing diversified production technologies by providing them with information and/or support in the various fields of production. This is achieved through meetings with input suppliers and visits to production sites within and outside the project area.

(2) TDG monthly review and planning meetings

During these meetings the following issues are addressed: (i) definition of the mandate and initial objectives (first meeting); (ii) assessment of training needs (second meeting); (iii) planning the production and other technology development activities to be conducted by the members of each TDG during the coming period; (iv) selection of micro-projects and other initiatives which could benefit from special project support; and (v) selection of existing production activities which could be used for demonstration; and evaluation of results of all past activities carried out with the group.

(3) Farmers' pilot/micro-projects and initiatives

Significant financial assistance will be offered to assist with setting up pilot projects since they involve a relatively high investment for which farmers are not willing to take the risk unless they are shown the worthiness, viability, and sustainability of the projects.

Priority will be given to advanced technology-based pilot projects, with an emphasis on quality, which deserve special attention and financial assistance by the project team. These include model intensive orchards for the production of bananas, pineapples, and litchis;

model hydroponics units for the production of specialty vegetables; and post-harvest units.

(4) On-farm adaptive trials

Numerous on-farm trials will be implemented throughout the regions of the project for producing new vegetable crops under a drip fertilization system, and for applying integrated pest management. Irrigation schedules will be optimized using specific irrigation monitoring equipment.

(5) Demonstrations and field days

Field days (either half or full days) to these demonstrations sites will be organized by the project team at regular intervals. Presentations will cover both the technical and economic bases for success. Demonstration sites will include pilot and micro-projects and on-farm trials, as well as successful projects/enterprises within and in the vicinity of the project area.

(6) Study or conducted tours

The project will organize combined visits to several relevant sites both local and abroad for small groups of farmers so that they can reach a better understanding of the different existing options for the development of their respective technologies.

(7) Farmers' technical training

Short courses will be provided by a short-term specialist (either international or local) and/or AREU staff on the following topics:

- Basic concepts of quality and norms for export (fruits, vegetables and processed products);
- Vegetable production (including fertilization and IPM);
- Fruit production (including fertilization and orchard management);
- Fruit nurseries (including plant propagation, nursery production, and modern nursery management);
- Vegetable nurseries (including nursery production and management);
- Vegetable seed production; and
- Training in water management.

Participatory services development

(1) Technical assistance to SDWs

The PIU team will assist SDWs and other farmers, through visits, meetings, and studies, in the following areas:

- Farm mechanization, including the availability and cost of farm equipment and identification of production operations with potential for mechanization; and

- Marketing, including market research and marketing skills, and group marketing issues.

(2) SDW monthly review and planning meetings

During these meetings the following issues are addressed: (i) definition of the mandate and initial objectives (first meeting); (ii) assessment of training needs (second meeting); (iii) planning of complementary service activities to be undertaken by each SDW during the forthcoming period; (iv) selection of pilot projects and other initiatives which could benefit from special project support; and (v) evaluation of results of all past activities carried out with the work group.

Each group will be guided and followed-up by a specific SDW support team, composed of one specific extension officer, one specific technical resource person, and the concerned STS (international or local) when on mission.

(3) Pilot projects

Financial assistance is provided to assist in setting up of pilot projects since they involve a relatively high investment for which farmers are not willing to take the risk.

It is therefore proposed that technically sound, economically viable, and potentially replicable complementary service pilot projects and initiatives proposed by farmers and/or groups of farmers be financially supported. Examples include four plots of fine de-rocking, plowing, furrowing, or bed forming (of 0.5 ha each) and the purchase of two-wheel tractors, potato lifters, or any other equipment that would enable mechanization of farm activities.

(4) Information distribution to farmer's community

It is proposed to circulate a simple newsletter on a quarterly basis (black and white photocopy), prepared by the beneficiary farmers, to farmers living in villages and hamlets located within and around the project area. In addition, this newsletter or its main articles could be also posted on the AREU/BSU website, in linkage with the MIS.

(5) Farmer' service training

Training courses will be provided to key members and representatives of the SDWs by the respective short-term specialists in the following topics: food crops irrigation, farm mechanization, cooperative use of equipment, production management, financial management, market research and marketing skills, group marketing issues, and use of the MIS.

The selection and extent of training subjects will be demand-driven and based on preliminary training need assessments carried out with the participation of farmers.

DR2- Delivery and extension of agricultural support services enhancement of developing AREU agro-economic support services

(1) Documenting production economics per product

It is proposed that a significant number of field surveys be conducted for different crops currently grown in planters' fields and for those having a potential for development in project areas.

These surveys will be carried out over a 5-month period for some 30 different products (15-20 crops with different varieties and technical scenarios for each crop) with two to three replicates per product in order to secure the accuracy of data.

(2) Support for management of small-scale farms

Typical project outlines will be produced from which feasibility studies for the principal crops identified by the beneficiary farmers can be derived. The first economic crop outline for pineapple is included in the Appendix.

Moreover, a manual on farm management will be prepared for publication. This manual will serve as a basic guide to beneficiary farmers to assist them in the financial management of their farms.

Strengthening AREU's applied research capacity

(1) On-farm trials and experiments

A series of on-farm adaptive trials will be undertaken under different types of irrigation systems, e.g., micro-sprinkler and drip irrigation, for different types of crops.

(2) Establishing a documentation center at AREU Mapou

A documentation center is being set up at the AREU Mapou Demonstration Centre, which focuses on specialized documents for diversification issues, to be used by researchers, extension staff, and farmers.

(3) Extension booklets, leaflets, and videos

Information leaflets on 10 principal crops identified for the project area are being prepared. In particular, information concerning the economics of production (such as investment, production costs, and expected returns) and potential market opportunities will be included. Furthermore, since proper pest and disease detection is a key element to effective pest control, a manual on pests and disease identification is being prepared to complement the information leaflets. These information materials will be pre-tested with local farmers (language, text, illustrations, graphics, etc.) before the resulting material is disseminated on a large scale to farmers in the project area.

(4) Increasing the availability of seeds, planting materials, and agricultural inputs

Local producers are presently using traditional systems of producing seedlings, which is very labor-intensive. To this effect, there is a need to modernize seedling production at the grower's level by introducing appropriate technology and evaluating them under local conditions.

The possibility of initiating commercial production of vegetable seedlings will be investigated with a view to serving the needs of both the local producers in the North and producers of other regions in Mauritius. If the need materializes, a model vegetable nursery will be set up either at AREU Mapou or on a farmer' plot within the project area.

A similar exercise as that proposed for vegetable seedlings will be undertaken for fruit planting material.

DR3- Market information system implementation and an operational

Market information system (MIS)

The MIS will make available to domestic operators and to institutions responsible for sector's development the following information:

- More-precise and timely production information for a wide range of fruits and vegetables (annexed MIS bulletins);
- Additional data on the production performances of four seasonal fruits (litchis, papaya, mango, and citrus fruits), in addition to two other ones (banana and pineapple) whose yields are already regularly being monitored; and
- Specific production information (yields and expected production levels) for six main domestic fruits so as to support their export trade.

The information products and services will be finalized by AREU and circulated by using the most-appropriate media. It is understood that before they are circulated, the products and services generated will have to be adapted to the selected media. Different information carriers will be used to circulate the information.

Market research

(1) Market research to support domestic trade

An investigation among members of the country's Hotels & Restaurants Association (AHRIM) of the tourist industry will be organized so as to better ascertain the systems they currently use for procuring horticultural products, what constraints they face, and the existing potentials for establishing direct linkages with producers inside the project area (through

contracts) and/or for using the trade facilities to be set up by the project to procure horticultural products in a more-efficient and timely manner.

(2) Market research to support horticultural exports

Jointly with selected exporters and in collaboration with the Mauritius Industrial Development Authority (MIDA), an export promotion institution, the project will carry out one to two external market investigations so as to support specific export attempts by domestic horticultural exporters.

Preliminary Observations

Farmers and groups

- The approach adopted by the project for the formation and development of the farmers groups, i.e., bottom-up, needs-driven, and people-centered, will take more time to implement but will produce better results in the end.
- Farmers have not experienced this kind of involvement and participation before. They do not have previous experience in working together on a common problem. Thus, the first steps will necessarily be slower until mutual trust and self-confidence are built up.
- Diversity among farmers as far as farm size, education, and self-exposure in market decisions is also a limiting factor.
- The fact that the farmers do not live in the same community/village area makes group development much more difficult. Also it is more difficult to accept and trust the leadership, at least initially, until the group realizes its devotion and that it does not have a hidden agenda.
- Farmers are invited to canvass as many other farmers as possible from their community to join the group. The geographic factor of the group might prove to play an important role in facilitating group development.
- There is a risk that farmers will lose interest in participating in the group formation if tedious and time-consuming meetings continue without tangible results. For this reason, it is recommended that "small achievable objectives, i.e., tasks" be undertaken so to maintain group vitality.

The importance of the extension team

- The formation of farmers' groups and their operation depend very much on members' behavior and participation. The goal of extension is to develop their skills in group management to facilitate group work.

- The new market environment in the agro-food sector makes farmers more demanding in terms of financial, market, and organizational advice, although technical advice remains very important. These new skills need to be developed among the extension staff.
- The extension team should avoid developing a feeling in the groups that they will do everything. Decisions, commitments, the setting of priorities, implementation, etc. of activities should remain with the group members, while the support team should provide only facilitation and support.
- For substantial progress at this critical phase, extension officers assigned to the groups are to maintain permanent contact with the group.

Conclusions

The project life was originally 4 years, but due to administrative reasons at the European Union, this has been reduced to 2 years. Technology transfer is a slow process which planters need to evaluate and adopt. Hence it is not expected that the project will actually achieve its objective of having 700 ha under food crop and fruit tree cultivation. Project objectives are now centered on enhancing AREU's support capacity and producing a core group of agricultural entrepreneurs who will develop the necessary knowledge and technical skills in the use of modern agricultural technologies and farm management tools. They in turn will pave the way towards improved and sustained crop production. Ultimately by 2007, the following will be achieved:

(a) The welfare of small planters in the northern region will be improved through increased income from agricultural activities; and

(b) The country's dependence on imported fruits and vegetables will be reduced.

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Impact of Technology Transfer to the Growth and Development of Agriculture Sector in the Philippines

Marites S. Balhon[1] and Anna Liza F. Bonagua[2]

Background

Agriculture plays an important role in developing countries. In Philippines, agriculture is a major contributor to our economy, as it accounts for significant portion of Gross National Product – of about 22%. Agriculture provides income and livelihood to millions of farmers and fisherfolks as well as their dependents. It employs about 50 percent (50%) of the labor force, furthermore, majority of the people are in the rural agriculture sector (see Table 1). Agriculture also enables traders, retailers, processors and other groups to directly and indirectly make a living from the sector.

Majority of the poor families are in the rural areas and dependent on agriculture and agriculture-related industries for employment, livelihood and income. As such, agricultural productivity must be pursued by introducing a comprehensive development program which would impact on the socio-economic conditions of this rural poor.

To meet this challenge, the Philippines takes its banner program for agricultural development – the "Ginintuang Masaganang Ani"[3] – "High Value Commercial Crops (HVCC)". This is a transitional blueprint to operationalize *the Agriculture and Fisheries Modernization Act* of 1997 (AFMA) or *Republic Act 8435*.

AFMA focuses on achieving food security and poverty alleviation through modernized agricultural and diversified rural economy that is technologically advanced and globally competitive. It is envisioned that as agriculture modernized, safeguards will also have to put in place to ensure that intensified production activities do not undermine the integrity of the environment.

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3 Translated as golden harvest which means bountiful harvest and productivity

Agriculture and Rural Development – Status and Trends

For the past decade, the productivity and competitiveness of agriculture and fisheries sector in the Philippines generally has not improved both in broad and specific indicators in productivity. In many studies, it is shown that labor productivity has been sluggish and only is exhibiting an annual average of 0.56% from 1993-1999 (see Table 2).

In rice yields, there is an inadequate rice production and output continued to be low relative to national requirement (see Table 3). Coconut productivity is as well lagging compared to most Asian countries and remained relatively stagnant during the last decade.

Fisheries sector continue to show declining productivity as highlighted by the 1.8 % decline in freshwater aquaculture yield from 1989-1991 as shown in Table 4.

Because of this insufficiency of food supply, Philippines turn from net exporter to net importer in food and agriculture in the world market as early as 1994 particularly as major export commodities such as coconut, banana and pineapple has declined. (see Table 5).

Rural Development in the Philippines has not been broad-based whatever progress it must have attained to date. In many studies, done, rural poor have continuously increased even with the growth of agriculture Gross Value Added (GVA) has been on average (Table 6). Sad to say that for the past decades, rural welfare has not improved significantly in the country. Poverty continues to be a rural phenomenon with the rural sector accounting for three out of five poor Filipino families and majority of them are dependent on agriculture and agriculture-related industries for employment and income (Balisacan, 2003).

Relative to this condition, it has become imperative for the Philippine Government to introduce innovations and reforms in the agriculture sector in order to meet the requirements of productivity necessary to spur development in the rural areas, and impact on the lives of the rural poor.

Transforming the Agriculture and Fisheries Sector

To revitalize the situation experience by the country, the Philippines must create a modernized and socially equitably agriculture and fisheries sector. Crucial to the transformation is bringing new appropriate technologies that could overcome the agricultural productivity constraint to eventually provide an engine of growth required for the national economy.

According to Timmer (1998), only a dynamic, rapidly growing agriculture can generate the sustained surpluses necessary to drive the economic transformation. Whilst, it must be noted that not all countries that went on or are successful agricultural revolutions became industrialized and grow rapidly. This maybe because, as agricultural growth is necessary during the early stages of transformation it is but not sufficient to promote industrialization. For the country like the Philippines, one of the late-blooming countries, agricultural growth is important in supporting broad-based economic transformation.

The passing of *Republic Act 8435* otherwise known as the "***Agriculture and Fisheries Modernization Act (AFMA)***" paved the way for the transformation necessary. *AFMA* espouses policies that promote environment-friendly technologies and sustainable farming practices that conserve natural resources.

AFMA introduces key strategies that are required to support the perceived growth such as:

1. **Reforms** and reorientation in the provision of public production and marketing services.
2. **Human Resource Development** – Strengthening of the agriculture and fisheries education sector that offers high quality education.
3. **Research and development** – Rationalize and accessible research and development system on agriculture.
4. **Extension** – Integration and strengthening extension system built on strong partnership among the government agencies, local governments, private sector and civil society.
5. **Rural non-farm employment** – policies and programs to employ rural workers efficiently and promote rural industrialization.
6. **Trade and fiscal incentives** – exemption of all agriculture and fisheries enterprises from tariffs and duties in the importation of certain inputs.
7. **Budgetary appropriation provision –** providing for the needed steady stream of public investment support to agriculture and fisheries modernization.

It is the overall goal of *AFMA* to attain security and competitive self-sufficiency in food to enhance the country's capability in producing most of its food requirement and protecting them from the vagaries and uncertainties of the world market, which is plague by decreasing food supply. Increasing incomes and profits of the farmers and fisherfolks also is an implicit goal of the *AFMA*.

To carry out the plan of modernizing the Agriculture and Fisheries sector towards meeting the goal of improving the lives of farmers and fisherfolks as well address the problem of poverty, the "Ginintuang Masaganang Ani" – "High Value Commercial Crops (HVCC)" was introduced. HVCC is seen to provide alternative profitable opportunities to smallholders and lend well to value adding activities, marketing agreements and joint ventures with users or processors. This program likewise, provides the national direction and framework for harmonizing local initiatives.

Introducing GMA - High Value Commercial Crop

The "Ginintuang Masaganang Ani (GMA)" – High Value Commercial Crops program adopts a major shift towards market-oriented production systems by introducing the Commodity Producers Linkages with Users Scheme (Commodity-PLUS) as the basic reference in addressing the gaps in the commodity marketing systems. The implementation of the program requires the availability of market information and consumer trends, transfer of technology and information, proper channels to adequately ensure that information and technology reach the users.

The cross cutting effects of policy, legislation, institutional linkages and technology and markets defines the critical importance of creating an environment for market linkages to occur profitably.

a. Agribusiness System Participants – The consumer is the ultimate end user and the producer is the point of origin of food products. Program activities include understanding consumer trends, commodity flows and characteristics, marketing systems and practices to ensure the acceptance and unimpeded delivery of farmers produce to consumers. Knowing the buyers' specifications and price will guide producers on what production adjustments to be done.

b. Commodity-PLUS – identifying and matching with users or buyers require information about both parties to ensure that negotiations will take place.

c. Commodity Action Team – a core of specialists in different fields must be able to understand the commodity system and about industry trends to determine the critical gaps to be addressed. This will cover market intelligence and technology packaging to address the users requirements, and, provision of necessary support services for the parties to engage in commercial operations under appropriate business relationship.

Implementation strategies

GMA-HVCC requires the identification and matching with users and buyers requires information major program strategies include the nationwide development and promotion of high quality planting materials, development of harmonized product standards, cold chain systems and other appropriate modern post-harvest technology.

a. Market Driven – based production system for high value crops that are technologically cost efficient and competitive in local and export markets.

b. Commercial Testing and Technology – demos of integrated systems are established primarily for agro-based oriented enterprises, post harvest and processing technologies which later can be transferred to private sector or cooperatives under various privatization modalities.

c. Home Consumption Led Strategies – promotion of strategies that would enhance indigenous, nutritious crops that require minimal technology, labor and inputs. This is to improve the nutritional adequacy of Filipinos particularly those most vulnerable and nutritionally at risk due to poverty.

Implementation Components – Role of Technology Transfer

Agricultural and rural development is the key to poverty reduction and food security. This necessitates for a comprehensive strategy which require policy changes, public expenditure programs and the establishment or strengthening of national and local institutions which were facilitated by presence of appropriate technology.

1. Policy reform, market development and promotion

Leveling the playing field provides opportunities for new entrants to the industries as well as diversification into other industries or agribusiness functions in both forward and backward linkages. Competition is expected to drive industry players to find the best investment areas and is cost efficient and quality-oriented in view of a more stringent market requirements.

2. Human resource development and capacity development

A technology-driven growth in agriculture is possible only when the rural populace has the tools and skills necessary for modernization. Furthermore, investment in education has reinforcing effects in poverty through health, nutrition and higher productivity.

Extension systems provide venues for human development and generate externalities to the sector. These could be achieved through the dissemination of new technologies

coming out of the research and development activities. Demonstration farms as prescribed under *AFMA* have been used have been used to integrate the research and extension processes.

3. Infrastructure support

Increased public investment in rural infrastructure accompanied by reforms on land transport, inter-shipping and tele-communications, will bring down production and marketing cost. Opening of the Roll-On-Roll-Off (RORO) transport system enables the farmers and producers to directly bring their produce to the consumers.

Private sector investment in post harvest, processing, bulk handling and cold chain facilities are encouraged through a sound policy environment supported by technical and financial packages and other appropriate incentives.

4. Investment and financing

Under this component, the program focuses investment and financial packages that are referenced on commodity requirements and market specifications. Investment analysis and profitability levels as well as commodity market information and technology will be made available to lending institutions. Private sector resources will be matched with government resources on a cost-sharing scheme for developmental activities.

The government will provide public goods and services, guarantee and insurance to loans and extend loan grants to private sector supporting the HVCC program.

On the other hand, the private sector provide land, labor and capital and management skills for agribusiness enterprises.

5. Technology development, training, extension and communication support

This component focuses on the acquisition and/or development and promotion of mature and appropriate technologies for pre-production to production, post-harvest handling and marketing to include processing.

The delivery of extension services now devolved to LGUs, it decentralizes decisions on matters pertaining to technology dissemination and, identification of appropriate development projects. With localized decision making, needs of the community are better identified, thus, appropriate technologies, and projects, have better chances of being adopted.

6. Program advocacy, information networking and dissemination

A continuing advocacy and consultation with industry players is an integral part of the program.

The establishment of the Open Academy for Philippine Agriculture (OPAPA) is a major stride in promoting agriculture on a scale never seen before in the country. The agriculture knowledge generators, learning centers, and agricultural training institutes can now converge and link up with any network backbone to provide on-line information services, knowledge databases, diagnostic tools and interactive forum.

Through this network, individuals and organizations can collaborate in an open environment where technicians and farmers can seamlessly draw knowledge and information services related to agriculture, using PC or cell phone. This shall give options, a basket of technologies, information that shall empower farmers to make better decisions, increase their productivity and livelihood. "This is a victory for the farmers, especially rice farmers whom the program initially supports, diversifying into rice-based systems, livestock, and other small holder systems (Dar, 2003)."

7. Institutional linkages and stakeholders participation

To attain and achieve food sufficiency and make the *AFMA* work, it is important that stakeholders participate totally in the program.

Issues on technology and information exchange can fall on the ambit of government and government-private cooperation.

Local Government Units, being in the forefront of rural development in a decentralized system of government, lead in developing local plans and programs that are suitable to their peculiar localities. Other stakeholders in the community are also encourage to participate in this undertaking to further define the priority areas where balanced agro-industrial enterprises which gives opportunities for backward-forward and vertical-horizontal integration can be harnessed.

Non-government organizations have been quite effective in community organizing and capability building for rural communities.

Conclusion – What happens then?

The shift to appropriate technology-based, labor employing, value added-driven agriculture and fisheries is hopeful to create a modernized and socially equitable agriculture and fisheries sector. The present administration does not accept the increasing poverty and inequality as the necessary cost and results of development. Therefore, the most vulnerable comprising that of the rural poor must be sheltered from the pains of adjustments and effects of macro-economic policies.

It is targeted that agricultural crops sub-sector is expected to grow annually by an average from 2.4 to 3.6 %. Traditional crops such as rice, corn, coconut, and sugarcane will show moderate growth and that the growth in crops sub-sector will be led by high value and export crops (tropical fruits and vegetables) are expected to register average growth rates from 3.4 to 5.7 %.

In the overall, the transformation of the agriculture and fisheries sector through the introduction of High Value Commercial Crops under the "Ginintuang Masaganang Ani" Program of the present administration is something that has yet to be seen in the coming years. Whether the Philippines have introduced the appropriate technology to spur rural development is left for the Filipinos to see in the coming months. Cororaton (PIDS, 2002) may argue that the country may find it hard to attain a productivity-based sustainable growth through technological innovation-based strategy due to the low investment in research and development.

It must however be understood that sustainable agricultural technologies are generally concerned with the need for agricultural practices that are economically viable and enable the rural people to meet their needs for food. Thereby, these should be environmentally sound and concerned with quality of life. Therefore, since these can be achieved in various ways, it is argued that sustainable agricultural development may not necessarily be linked with any particular technological practices. Rather, the technologies necessary for agriculture-based economies have to be adaptable and flexible over time to respond to the demands for food and fiber, demands for the efficient use of natural resources for production and be able to protect the soil and the resources (Sustainable Agriculture and Rural Development Concept). The perceived gains and improvement in labor productivity, as shown in Table 2, may have been due to technological innovations, and policy reforms and strategies adopted by the *AFMA*.

The Ginintuang Masaganang Ani (GMA) program under the *Agriculture and Fisheries Modernization Act* (*AFMA*) of 1997 is hoped to eventually meet the challenge for the Philippines to find an appropriate mix of policies and institutions necessary to exploit the benefits of globalization while taking stock and ever watchful of its downside risk.

THE AGRICULTURE AND FISHERIES MODERNIZATION ACT OF 1997

The Agriculture and Fisheries Modernization Act (*AFMA*) of 1997 is a comprehensive legislation that provides for the country's blueprint for the sector's modernization and rural development It defines the necessary policy environment and deliberate public investment stream that will transform the rural economy into one that is modem, science and

technology-based, more integrated into the national and antinational markets, and thus highly productive and competitive. *AFMA*'s major provisions include:

1. Reforms and reorientation in the provision of public production and marketing services.
    - Focus and concentration of public investments on identified Strategic Agriculture and Fisheries Development Zones (SAFDZs), which are defined geographical areas of competitiveness and comparative advantage based on biophysical and socioeconomic endowments;
    - Crafting and execution of medium- and long-term Agriculture and Fisheries Modernization Plans (AFMPs), in full consultation with all stakedolders and based on the SAFDZs;
    - Phase-out and consolidation of directed credit into the Agro-industry Modernization Credit and Financing Program (AMCFP);
    - Specific principles and guidelines for irrigation and watershed development, providing for economic cost recovery, and the devolution of communal systems to LGUs, promotion of private sector-led development of minor systems;
    - Establishment of the National Marketing Assistance Program (NMAP) and National Information Network (NIN);
    - DA-DPWH-LGU coordination in the formulation and implementation of the Agriculture and Fisheries Infrastructure Plan; and
    - Product standardization and consumer safety, through the establishment of the Bureau of Agriculture and Fisheries Products Standards (BAFPS).
2. Human resource development. Rationalized and strengthened National Agriculture and Fisheries Education System (NAFES) the offers high quality agriculture and fisheries education at all levels.
3. Research and development. A dynamic, client-responsive, rationalized National Research and Development System in Agriculture and Fisheries (NARDSAF) under the coordination of the Department of Agriculture.
4. Extension. Integrated, strengthened and rationalized system of National Extension System in Agriculture and Fisheries (NESAF) built on strong partnership among the NGAs, LGUS, civil society and the private sector that is fully responsive the needs of the fishing and farming communities.
5. Rural nonfarm employment. Policies and programs designed to employ workers efficiently in the rural areas through a basic needs approach, promotion of rural industrialization.
6. Trade and fiscal incentives. Exemption of all agriculture and fisheries enterprises from tariffs and duties in the importation of specific types of inputs.

7. Budgetary appropriation provisions. Provides for an initial year P20 billion funding for AFMA and P17 billion annually for the next 6 years. For period 2001-2004, an annual budget of P20 billion will be allocated to implement AFMA, providing for the needed steady stream of public investment support to agriculture and fisheries modernization, as follows:

   · Irrigation P6 billion

   · Capability building P1 billion

   · Post-harvest facilities P2 billion

   · NAFES P1 billion

   · Credit and financing P2 billion

   · NIN P800 million

   · Other infrastructure P2 billion

   · Rural nonfarm

   · R&D P2 billion employment training P350 million

   · Marketing assistance P1.6 billion

   · Identification of SAFDZs P50 million

   · Salary supplement of extension workers P1.2 billion

Table 1. Total labor force and employment in agriculture, 1981-2000 (level in millions)

Year	Total labor force	Total employed		Employed in agriculture			G.R. (% share)
		Level	% to labor force	Level	Growth rate (%)	% to total employment	
1981	18.2	16.7	91.3	8.5	-0.6	51.1	-4.7
1982	18.5	16.7	90.6	8.7	2.8	51.9	1.5
1983	20.1	18.5	92.1	9.1	4.6	51.3	-1.2
1984	20.8	18.6	89.4	9.3	1.9	50.8	-1.9
1985	21.3	19	88.9	8.6	-7.3	47.5	-6.5
1986	22.1	19.6	88.9	9.9	15.3	52.7	11
1987	22.9	20.8	90.9	9.6	-3.2	48	-9
1988	23.5	21.5	91.7	10	3.7	47	-2
1989	23.9	21.9	91.6	9.9	-0.7	45.2	-3.9
1990	24.5	22.5	91.9	10.4	4.8	46.7	3.4
1991	25.3	23	91	10.3	-0.9	44.9	-3.9
1992	26.2	23.9	91.4	10.7	4.2	45.3	0.8
1993	26.8	24.4	91.1	11.1	3.9	45.7	0.9
1994	27.5	25.2	91.6	11.3	1.3	45.1	-1.3
1995	28	25.7	91.7	11.1	-1.2	43.4	-3.7
1996	29.6	27.4	92.6	11.6	4.5	42.8	-1.3
1997	30.3	27.9	92.2	11.3	-2.8	40.8	-4.7
1998	31.3	28.3	90.4	10.9	-3.4	39.2	-4
1999	32	29	90.6	11.6	6.3	40.1	2.4
2000 a/	31.1	27.5	88.3	10.2	-5.5	38.1	-5

a/ Based on 1995 Census-based population projections; previous series were based on 1980 Census-based population projections

Source: NSCB

Table 2. Labor productivity indicators, 1993-1999 (growth in percent)

Indicator	1993	1994	1995	1996	1997	1998	1999	1993-1999 Average
Real labor productivity	-0.8	1.7	2.1	0	3.2	-1.2	-0.7	0.6
Agriculture	-1.7	1.3	2.1	-0.6	6	-3.4	0.2	0.6
Industry	2.2	1.9	1.8	-0.6	1.6	-0.9	1.6	1.1
Services	-0.7	0.4	-1	-0.5	-0.4	-1.7	0.5	-0.5

Sources: NSCB and National Statistics Office (NSO)

Table 3. Rice production and use, Philippines, 1978-2000

Year	Beginning stocks ('000MT)	Production ('000 MT)	Imports ('000 MT)	Exports ('000 MT)	Total supply (a) ('000 MT)	Total usage (b) ('000 MT)	Ending stocks (a-b) ('000 MT)	Per capita (Kg/Year)	Production-usage gap ('000 MT)
1978	1,308	4,615	0	48	5,875	4,281	1,594	83.2	334
1979	1,594	4,957	0	166	6,385	4,500	1,885	85.2	457
1980	1,885	4,970	0	263	6,592	4,945	1,647	92.2	25
1981	1,647	5,142	0	95	6,694	5,082	1,612	92.5	60
1982	1,611	5,417	0	1	7,027	5,161	1,866	91.5	256
1983	1,866	4,756	0	40	6,582	5,091	1,491	89.0	-335
1984	1,491	5,120	190	2	6,799	5,652	1,147	96.8	-532
1985	1,147	5,759	538	0	7,444	5,689	1,755	94.3	70
1986	1,755	6,047	2	0	7,804	5,787	2,017	93.3	260
1987	2,017	5,585	0	111	7,491	5,916	1,575	94.0	-331
1988	1,575	5,867	181	0	7,623	6,106	1,517	94.7	-239
1989	1,517	6,186	220	16	7,907	6,218	1,689	93.9	-32
1990	1,689	6,095	593	0	8,377	6,478	1,899	97.2	-383
1991	1,899	6,326	0	10	8,215	6,098	2,117	88.5	228
1992	2,117	5,970	0	35	8,052	6,361	1,691	91.2	-391
1993	1,691	6,132	202	0	8,025	6,584	1,441	92.3	-452
1994	1,441	6,850	0	0	8,291	6,792	1,499	91.5	58
1995	1,499	6,851	263	0	8,613	7,191	1,422	94.3	-340
1996	1,422	7,334	862	0	9,618	7,821	1,797	99.9	-487
1997	1,797	7,325	722	0	9,844	7,868	1,976	97.8	-543
1998	1,976	5,560	2,171	0	9,707	7,423	2,284	91.7	-1,863
1999	2,284	7,662	834	0	10,780	8,425	2,355	99.1	-763
2000	2,355	8,053>	617	0	11,025	8,837	2,188	103	-784

Source: BAS

Table 4. Freshwater fish production, Philippines and selected Asian countries, average for 1989-1991 and 1996-1998 (in metric tons)

Country	Average production 1989-91	Rank	Average production 1996-98	Rank
Thailand	228,982	3	476,194	1
Japan	394,875	1	464,852	2
Viet Nam	227,922	4	414,833	3
Philippines	373,291	2	302,977	4
Myanmar	154,318	5	242,288	5
Malaysia	24,281	8	52,109	6
Korea, Rep.of	47,970	6	42,451	7
Laos	28,333	7	40,083	8

Source: FAO

Table 5. Philippine merchandise trade profile, 1992-2000 (US $ million)

Year	Exports			Imports			Trade Balance	
	Agri Products	Total	% Share	Agri Products	Total	% Share	Agri Products	Total
1992	1,854	9,826	18.9	1,560	14,522	10.7	294	-4,696
1993	1,918	11,378	16.9	1,626	17,600	9.2	292	-6,222
1994	2,072	13,483	15.4	2,114	21,333	9.9	-42	-7,850
1995	2,499	17,447	14.3	2,649	26,538	10	-150	-9,090
1996	2,307	20,543	11.2	3,096	32,427	9.6	-789	-11,884
1997	2,338	25,216	9.3	3,102	35,942	8.6	-764	-10,726
1998	2,225	27,878	8	2,895	38,853	7.5	-670	-10,975
1999	1,760	35,032	5	2,878	30,742	9.4	-1,118	4,290
2000*	1,906	38,078	5	2,386	31,386	7.6	-481	6,692

* Preliminary estimate

Source: NSO

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4. "Ginintuang Masanang Ani" Program – Department of Agriculture, Philippines (web site: //www.da.gov.ph).
5. National Economic Development Authority – Medium Term Philippine Development Plan 2001-2004 – Chapter 7 and 8 (Web site: //www.neda.gov.ph).
6. Republic Act 8435 – Agriculture and Fisheries Modernization Act (AFMA).
7. Transforming the Rural Asian Economy "Importance of Agriculture in Promoting Transformation".

Submission to Workshop on Agricultural Technology Transfer

The Workshop Noted that:

1. Agriculture is the mainstay of the economy of AARDO member countries. It employs a substantial proportion of the population of these countries and contributes a range of between 10-40 per cent to the GDP; provides employment directly on an average to about 60 per cent of the total population in these countries and forms an important platform for progress in the industry and service sectors.

2. Productivity and competitiveness of agriculture have generally been low over the past two decades even though it provides employment to a large population. A very large proportion of farm holdings are small. Evidence from country poverty profile reveals that agriculture contributes the largest population of the poor with women forming a significant percentage of the poor segment.

The Workshop Concluded that:

i) Agriculture, for a long time to come, will still remain the mainstay of economic development in developing countries. Even in developed countries of AARDO, agriculture still plays an important role in food security for some AARDO's developed member countries.

ii) Productivity and Competitiveness of agriculture needs to be improved significantly and care be taken to avoid mistakes encountered in the implementation of the Green revolution.

iii) Reforms need to be undertaken in at least two areas:
   - farmers and agribusiness organisation
   - agricultural administration and research

iv) Technology transfer to be recognised as a system/package designed to establish a network of linkages particularly between researches, transfer agents and farmers/organisation etc.

v) Technology transfer process be participatory in design to make beneficiaries owners of the technology.

vi) Technology transfer to be designed to favour specific target groups eg. Small and marginal farmers, and be gender sensitive.

vii) World Trade Liberalization posed a serious challenge to agricultural development in developing countries and threatens food security in some AARDO member countries.

viii) Technology transfer offers a crucial tool for improving agricultural development.

Recommendations

i) Technology Transfer to be responsive to the needs of the beneficiaries.

ii) All member countries of AARDO take steps to establish institutionalise a pragmatic technology transfer system;

iii) Develop a follow-up farming programme for extension agents as part of a capacity building efforts in the agricultural sector;

iv) Establish integrated approach to link research and extension and to include farmers associations.

v) Institutions should evaluate relevance and the peculiarity of the situation in the choice of appropriateness of a technology;

vi) Technology Transfer should be gender sensitive taking into consideration the cultural and political environment;

vii) Re-evaluate through cross-country studies and existing extension practices, eg. T&V as a means of re-packaging more effective approaches;

viii) Governments to institute policies in areas of agrarian reforms, financial support, institutional and infrastructural development in support of the agricultural sector;

ix) Governments/Donors to facilitate programmes designed to encourage young and literate persons and new entrants into agriculture;

x) AARDO to improve and intensify exchange of good experiences of Technology Transfer among member through field visits or exchange of experts programme;

xi) AARDO to work towards identifying relevant technology transfer experiences in support of poverty reduction; (and seek donors support for disseminations).

xii) Governments to package, plan and seek donor support for technology transfer;

xiii) Member Countries and AARDO to join coalition of forces to find acceptable position for developing countries in view of challenges posed by world trade liberalisation;

xiv) Design of technology transfer programmes should be participatory for sustainability using well established tools of PRA; (using different media to facilitate a bottom-up approach system) .

xv) Government to increase investment in technology transfer and/or facilitate the environment for public/private sector participation; and

xvi) Member counties to facilitate the roles played by NGOs and CSOs.

Closing Remarks

Closing Remarks

Dr. Bing Huei Chen

Deputy Director General
Agricultural Research Institute

Honorable Chairperson, distinguished resource speakers, dear participants, ladies and gentlemen:

The six-day AARDO International Workshop on "Agricultural Technology Transfer and Its Consequences" has been accomplished very successfully. On behalf of Agricultural Research Institute and the Council of Agriculture of the Republic of China, I am extremely honored to chair this very special closing ceremony. First of all, I would like to give my sincerest gratitude to all of you, especially our distinguished speakers, moderators, and delegations from overseas. The success of the Workshop depends totally on your active participation, the valuable presentation of resource papers and country reports, as well as the useful discussion and exchange of ideas among all the participants. In addition, I would like to thank AARDO officials. Their great effort is essential to the materialization of this very meaningful and important Workshop. I also appreciate my colleagues, the staff members of ARI, for their devotion and hard-working before and during the process of the Workshop.

In view of the rapid development of life science, especially biotechnology, it is timely that AARDO, with the cooperation from the Republic of China, organized this Workshop. The goals of the workshop were to review the overall methodologies and achievement of technology transfer, to highlight the neglected issues in technological changes, and to identify the problems and constraints of technology transfer in relation to a more balanced agricultural development. From the participants' informative presentation and thoughtful discussion during the past week, I believe that you would agree with me that the dissemination of technology is just as important as technology itself, in terms of promoting rural development. I also believe that after the Workshop, each one of you will go home like a farmer with bountiful harvest. You will be able to contribute more to your people the successful application of agricultural production in your country.

In the field trip during the past two days, you had visited several public and private sectors of agricultural research and production, such as the Taiwan Sugar Company (TaiSuCo), AVRDC, and orchid nurseries. I presume that you have gained some ideas of the

research and management in the agricultural fields of this country. Taiwan has been successful in developing new technologies and transferring them to the farmers. We would like to share our experiences with you in the future. On the other hand, I also wish that we could learn more from your side. Through mutual cooperation, I think that we could do more and better to benefit our farmers, traders, and consumers on the whole.

Well, there is always an end to every happy gathering. In closing, I would like to say it again. Thank you, Dr. Bahar Munip and the AARDO officials, for your excellent leadership in organizing this Workshop. Thank you, all participants, for your excellent presence and contribution to this Workshop. I would like to express my special thanks to the staff members of the organizing committee. Without their endeavor and hardworking, this workshop would not be so successful and fruitful.

Finally, I wish you all the success. And to our foreign guests, a very safe and pleasant journey backs home.

Thank you.

Thanks Remarks

Dr. Yukio Abe
Manager (Training), IDACA

Representatives of COA and ARI, AARDO officials, distinguished guests, fellow participants and ladies and gentlemen, I consider this as a great privilege and honor to have been invited to speak on behalf of the international workshop participants.

First of all, on behalf of my fellow participants, I would like to express my sincere appreciation to AARDO, particularly, DR. Bahar Munip for providing us the fine opportunity to invite us to Taiwan, the beautiful island known as Formosa named by Vascoda Gama many centuries ago for participation in the International Workshop on Agricultural Technology Transfer and Its Consequences. I would also like to thank the Council of Agriculture and its relevant research Institutes for the good care and arrangements. We have enjoyed our stay in Taiwan under the care of both AARDO and COA.

Looking back, it seems that a week-long workshop has passed very fast, like the sayings of "Time flies like an arrow". Short as the period of our stay was, we found that the workshop was very fruitful and useful with keen discussion and interesting visits. No doubt, honestly speaking, I personally felt that the workshop program has been a little hectic but I can say that on the whole it has been well organized in the sense that we could not only glean the new knowledge about the topic, but also Taiwan's agricultural technology transfer efforts, its culture and the way of life of the people and etc.

Moreover, we did not know each other before the workshop, but by now have made friends with each other and thus could return to respective countries with fond memory. As the proverb says, "Do what the Romans do when we are in Rome", it would be one of the best policies for us to have appreciation about things Taiwanese like punctuality of time and etc. During our stay, we have closely observed and witnessed that Taiwan is highly developed with the spirits of diligence and hardworking of the people, thereby leading to the prosperity of the country.

We sincerely hope that the friendship, co-operation as well as exchanges through this kind of workshop among AARDO member countries will further grow in the future in our efforts to help alleviate the poverty. Let us strive for establishing an equitable society, more peace and prosperity with a little bid more care to those underprivileged!

Last but not in the least, let us thank Dr. Bing-Huei Chen, Deputy Director General of ARI and Dr. Sheng-Chung Huang and his colleges for the warm hospitality and care to us all participants. Indeed, you have succeeded in making us enhance our knowledge about agricultural technology transfer and most of all love your country!

More power to AARDO and Taiwan!!!

Programme Schedule

Date/Time Topic/Activity

Sun., 24 Aug. 2003

Arrival of the participants

Mon., 25 Aug.

09:30-11:00 **Registration** at ARI (Room: Auditorium, ARI)

11:00-11:40 **Opening Session**

Opening Remarks

--Mr. Ming-Lai Wang, Director General, COA

Welcome Address

--Dr. Chien-Yih Lin, Director General, ARI

Special Remarks

--Dr. Tom Lumpkin, Director General, AVRDC

Special Remarks

--Dr. Torng-Chuang Wu, Director General, FFTC

Inaugural Address

--H.E. Dr. Munip, Secretary General, ARRDO

11:40-12:00 **Group Photo Session**

12:00-13:30 Lunch Break

Session A: Moderator: H.E. Dr. Bahar Munip (AARDO)

13:30-14:20 Presentation of resource paper and discussion on topic "*The Mechanism Involved in Transfer of Agricultural Technologies*". By Dr. Tricia R. Javier, Applied Communication Division PCARRD, DOST, Philippines.

14:20-15:10 Presentation of resource paper and discussion on topic "*Taiwan Agriculture in the Era of Globalization*" By Dr. Ming-Ming Wu, Professor of Marketing Department, National Chung Hsing University, Taiwan.

15:10-15:30 Tea/Coffee Break

Session B: Moderator: Dr. Te-Yeh Ku (FFTC)

15:30-16:20 Presentation of resource paper and discussion on topic "*Case Studies on Transferring Technologies of Agribusiness-scale Production and Marketing of Asparagus and Mushrooms to Indonesia*". By Dr. Sung-Ching Hsieh, Professor, National Pintung University of Science and Technology.

16:20-17:10 Presentation of resource paper and discussion on topic "*Global Vision for AVRDC -- the World Vegetable Center*" By Dr. Tom Lumpkin, Director General, AVRDC.

18:30-21:00 Welcome Reception at *The Splendor – Taichung* hosted by COA, ROC

Ron: The Splendor – Taichung

Tue., 26 Aug.

Session C: Moderator: Dr. Tricia R. Javier (Philippine)

08:40-09:30 Presentation of resource paper and discussion on topic "*To Identify the Technology Transfer Methodologies and their Importance in Rural Development*" By Dr. Seong-Hee Lee, National Alpine Agricultural Experiment Station. Korea.

09:30-10:20 Presentation of resource paper and discussion on topic "*Technology Transfer through Information Dissemination: FFTC in the Sustainable Agriculture Partnership*" By Dr. Te-Yeh Ku, Adviser, FFTC.

10:20-10:40 Tea/Coffee Break

Session D: Moderator: Dr. Ming-Ming Wu (ROC)

10:40-11:30 Presentation of resource paper and discussion on topic "*Agricultural Extension Service and the Innovation Adoption in Taiwan*" By Dr. Yung-Chung Chiu, Counselor, COA, ROC.

11:30-12:10 Presentation of country paper and discussion on topic "*Transfer of Biocontrol Technology in Taiwan*" By Chi-Tung Chen, from ROC.

12:10-13:30 Lunch Break

Session E: Moderator: Dr. Seong-Hee Lee (Korea)

13:30-14:20 Presentation of country paper and discussion on topic "*Highlights of the Situation with Linkages among Researchers, Transfer Agents, and Farmers in Ghana*" By Ankrah Benjamin Nii Aryee, from Ghana.

14:20-15:10 Presentation of country papers and discussion on topic "*Consequences of Agricultural Technology Transfer on Weaker Sections in India*" By Ombeer Singh Tyagi, from India.

15:10-15:30 Tea/Coffee Break

Session F: Moderator: Dr. Sung-Ching Hsieh (ROC)

15:30-16:20 Presentation of country papers and discussion on topic "*How to Utilize Farmers' Organization for Agricultural Technology and Training in Japan*" By Yukio Abe, from Japan.

16:20-17:10 Presentation of country papers on topic "*Agricultural Extension Programs in Korea*" By Yeong Cheol, Cho, and "*Agricultural Technology Investment and Its Effects: Case of Korea*" By Kyeong-Duk Kim, from Korea.

18:30-21:00 Banquet party at *The Splendor – Taichung* hosted by H.E.Dr. Bahar Munip, Secretary General, AARDO.

Ron: The Splendor – Taichung

Wed., 27 Aug.

Session G: Moderator: Mr. M.K. Mensah

08:40-09:30 Presentation of country papers and discussion on topic "*The Role of Farmers' Organizations in Agricultural Technology Transfer in Malaysia*" By Sharifudin Jamaludin, from Malaysia.

09:30-10:20 Presentation of country papers and discussion on topic "*Impact of Technology Transfer on Economic and Socio-cultural Life of Rural Poor in India*" By Ramesh Kumar Sharma, from India.

10:20-10:40 Tea/Coffee Break

Session H: Moderator: Dr. R.K. Sharma (India)

10:40-11:30 Presentation of country papers and discussion on topic "*An Integrated Approach towards Sustainable Agricultural Development*" By S. V. Chung Ting Wan and V. Panchoo, from Mauritius.

11:30-12-20 Presentation of country papers and discussion on topic "*Basic information about agricultural technology transfer in Oman*" By from Oman.

12:20-13:30 Lunch Break

Session I: Moderator: Dr. Y. Abe (Japan)

13:30-14:20	Presentation of country papers and discussion on topic "*Impact of Technology Transfer to the Growth and Development of Agriculture Sector in the Philippines*" By Marites S. Balhon and Anna Liza F. Bonagua, Philippines.
14:20-15:10	Presentation of country papers and discussion on topic "*The Syrian Experience in Field of Modern Technology Transfer and Its Impact on the Rural Development Programs*" By Hazem Al Samman and Mowaffak Al Dbbyiat, from Syria.
15:10-15:30	Tea/Coffee Break

Session J: Moderator: Mr. M. K. Mensah (Ghana)

15:30-16:20	A brief introduction to ARI and its highlight on research
16:20-17:10	General discussion and recommendation of the workshop
	Ron: *The Splendor – Taichung*

Thu., 28 Aug.

07:30-09:40	From Taichung Hotel to TaiSuCo Orchid Nursery Center
09:40-10:30	Visiting Wu-Su-Lin Orchid Nursery
10:30-11:20	From TaiSuCo to AVRDC
11:20-12:00	Visiting AVRDC
12:00-13:00	Lunch at AVRDC
13:00-13:15	From AVRDC to Livestock Research Institute (TLRI)
13:15-14:00	Visiting TLRI
14:00-15:10	From TLRI to Janfusun Resortworld
15:10-17:50	Janfusun Fancy World
18:30-19:30	Dinner at Sun-up Café (Leisure Farming)
19:30-	Hotel Accommodation: The Prince Hotel in Janfusun Resortworld

Fri., 29 Aug.

08:00-08:10	From Janfusun Resortworld to Floriculture Research Center, ARI
08:10-09:00	Visiting Floriculture Research Center, ARI
09:00-09:40	From Floriculture Research Center to Ten-Wei Highway Garden
09:40-10:20	Visiting Ten-Wei Highway Garden
10:20-11:00	From Ten-Wei to Taichung Dist. Agri. Res. & Ext. Station (TDARES)
11:00-12:00	Visiting TDARES
12:00-12:50	Lunch at TDARES
12:50-13:00	From TDARES to Taida Hort. Co. Ltd.

13:00-13:40	Visiting Taida Hort. Co. Ltd.
13:40-14:30	From Taida Hort. Co. Ltd. to Dai Mushroom Co. Ltd.
14:30-15:10	Visiting Dai Mushroom Co. Ltd.
15:10-15:40	From Dai Mushroom Co. Ltd. to Taichung City
15:40-	Shopping and dinner at *Shin Kong Mitsukoshi* Shopping Mall
20:00-	Hotel Accommodation: *The Splendor – Taichung*

Sat., 30 Aug.

Morning:	**Closing Session: Moderator: Dr. Sanjeeb Kumar Behera (AARDO)**
09:30-10:20	**Summing-up and Conclusion Session**
10:20-10:40	Tea/Coffee Break
10:40-11:30	**Closing Ceremony** at ARI
12:00-14:00	Farewell Party hosted by Dr. Chien-Yih Lin, Director General, ARI at *Tong Hai Fish Village Restaurant*
Afternoon:	**Free Session**

Sun., 31 Aug.

Departure	Return of participants to respective countries.

List of Participants

List of participants of AARDO member countries

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FFTC Practical Technology

Plant protection
PT2002-7

Colored sticky traps for catching thrips in orchid crops

THRIPS are tiny insects less than 0.1 cm long which suck the sap of plants. One common species, Thrips palmiKarny, is often found on orchids growing in Thailand (Fig. 1).

These thrips are an important quarantine pest. The presence of thrips on cut flowers grown for export can mean that the importing country rejects the shipment, or insists on a disinfestation treatment.

Populations of thrips should be monitored routinely, as the basis for integrated pest control. Thrips are monitored either by visual inspection of a sample of plants, or by the use of sticky traps.

Adaptability of the technology

In the case of Dendrobiumorchids, the optimum sampling size for monitoring thrips is 40 inflorescences (flower heads) for each 1,600 square meters. In general, fields of orchids in Thailand are so large are (1.5 - 30 hectares) that monitoring for thrips by sampling plants is difficult.

Sticky traps are a low-cost technology used by farmers to detect pests in many crops, as the basis for timely and effective pest control (Fig. 2). The farmers can use recycled materials to make the trap cards.

Fig.1. A *Dendrobium* orchid

Fig. 2. Field of Dendrobiumorchids shaded by netting, with white sticky traps

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FFTC: An international information center for small-scale farmers in Asia

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Explanation of the technology

White and bright blue are the best colors for sticky traps used to capture T. palmi on orchids. Sticky traps hand-made by local people using white PVC board are as effective in trapping thrips as the commercially imported sticky traps (Fig. 3).

The traps should be at a height of 20 - 60 cm above the base of the plants. If they are placed at this height, they will catch more thrips than if they are placed at ground level.

For monitoring purpose, in order to see whether thrips are present, one or two sticky traps should be set out every 220 square meters of orchid plants (Fig. 4). Research has shown that this will give the number of thrips with a margin of error of 30%. However, for mass trapping, over a large area, sticky traps should be placed at a density of 100 traps per 1,600 square meters.

The economic threshold level at which pesticides should be applied is 10 thrips per 40 inflorescences per 1,600 square meters. If the thrips population is at or above this level, insecticides should be sprayed.

Using sticky trips to monitor populations and tell the farmer when insectides are needed reduces the use of insecticide sprays by 50%, compared to farmers standard practice of spraying at regular intervals.

Note: This technology has been successfully applied in the production of Dendrobium orchids in Nakhom Pathon Province and around Bangkok in Thailand.

Fig. 3. Tending orchids. Note the white sticky trap above the Worker's head

Fig. 4. Orchids in shade house with sticky traps

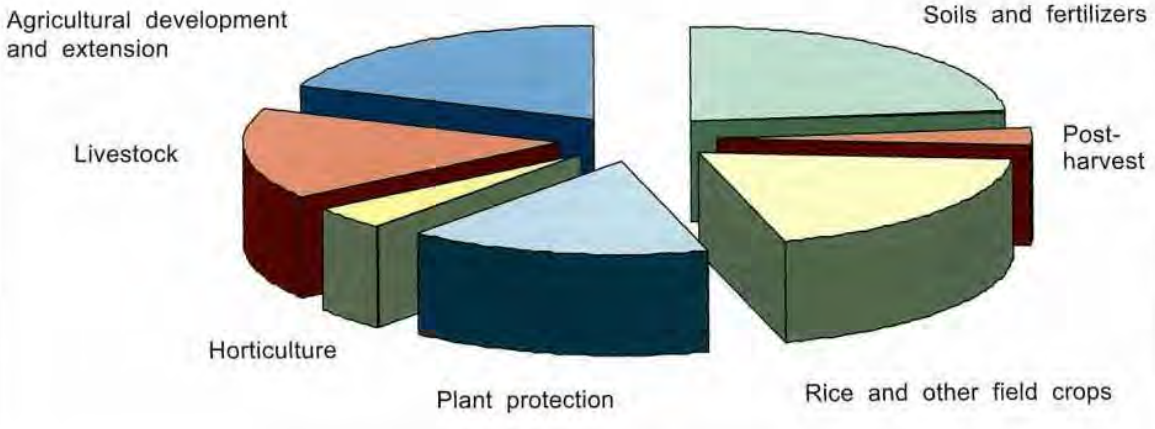
Appendix B: Activities of FFTC, 1970-2002

Soils

Soil is the fundamental resource of agricultural production. Some of the Center's early programs were concerned with classifying the agricultural soils of the Asian and Pacific region, and their fertility status. More recent programs have focused on sustaining soil productivity under chemical fertilizers and in slopeland areas by the use of organic materials and improved cultural practices.

Seminars and Workshops	1971	• Diagnostic techniques for soils and crops	Thailand
	1972	• Soils of the ASPAC member countries	Korea
	1975	• Hilly land development and soil conservation	Taiwan
	1976	• The fertility of paddy soils and fertilizer applications for rice*	Taiwan
	1981	• Mechanisms in the recycling of plant nutrients in agriculture*	Taiwan
	1983	• Ecology and management of problem soils in Asia*	Thailand
	1984	• Soil erosion and its countermeasures	Thailand
	1985	• Soil taxonomy and characterization of tropical soils	Taiwan
	1988	• The classification and management of rice-growing soils*	Taiwan
	1989	• Conservation farming on hillslopes*	Taiwan
	1989	• Yield losses due to the continuous cultivation of major economic crops*	Korea
	1991	• Improved vegetable production through the use of fertilizer, mulching and irrigation*	Thailand
	1992	• The proper use of chemical fertilizers combined with organic fertilizers in crop production*	Malaysia
	1992	• The Eleventh Technical Advisory Committee meeting on Sustainable agriculture for the Asian and Pacific region*	Korea
	2000	• The management of agricultural resources	Taiwan
	2001	• Recent composting technologies and their application	Taiwan
	2001	• Geographic information systems (GIS) in soil resources management	Philippines
	2002	• Soil and environmental quality	Thailand
Training Courses	1995	• Soil conservation management for sustainable slopeland farming*	Taiwan
	1995	• Appropriate use of fertilizers*	Taiwan
	1995	• Soil and plant analysis for fertilizer recommendations*	Taiwan
	1998	• Soil management for sustainable agriculture in the tropics	Taiwan
	1998	• Soil and plant analysis	Thailand

FFTC Programs according to field, 1970-2002



* Listed under more than one subject heading

Fertilizers

The high yields of modern agriculture depend on high inputs of plant nutrients from fertilizer, either chemical or organic. In the early years of the Center, most farmers in the region were only beginning to adopt the technology of chemical fertilizers and improved crop varieties. Early meetings were concerned with basic fertilizer technology and the economics of fertilizer use. Later programs have emphasized more effective fertilizer applications, using formulations such as slow-release pellets, and the use of organic materials to maintain long-term soil fertility.

Seminars and Workshops	1970	• Crop physiology and fertilizer application	Taiwan
	1971	• Fertilizer legislation	Japan
	1972	• Economics of fertilizer use (1)*	Taiwan
	1972	• Economics of fertilizer use (2)*	
	1972	• Production and evaluation of forage and fodder crops	Thailand
	1974	• Future pattern of fertilizer demand and supply in ASPAC countries*	Taiwan
	1974	• The utilization of cereal crop residues*	Japan
	1975	• Maintaining rice production in the face of a shortage of chemical fertilizer*	Taiwan
	1976	• The fertility of paddy soils and fertilizer applications for rice*	Taiwan
	1976	• The fertility of paddy soils and fertilizer applications for rice*	Taiwan
	1978	• Fertilizer management for rice*	Taiwan
	1981	• Biological nitrogen fixation and crop production*	Taiwan
	1981	• Mechanisms in the recycling of plant nutrients in agriculture*	Taiwan
	1982	• Nutrient recycling in agriculture with reference to the utilization of industrial wastes	Japan
	1984	• Fertilizer quality and efficiency	Japan
	1985	• Leaf diagnosis as a guide to orchard fertilization	Korea
	1987	• The impact of chemical fertilizer marketing and operation systems on rice production*	Korea
	1988	• The utilization of livestock and poultry manure*	Philippines
	1990	• The use of organic fertilizers in crop production	Korea
	1991	• Improved vegetable production through the use of fertilizer, mulching and irrigation*	Thailand
	1991	• Increasing nitrogen efficiency in upland crop cultivation*	Korea
	1992	• The proper use of chemical fertilizers combined with organic fertilizers in crop production*	Malaysia
	1992	• The Eleventh Technical Advisory Committee Meeting on Sustainable agriculture for the Asian and Pacific Region*	Korea
	1994	• The use of microbial and organic fertilizers in agricultural production	Korea
	1994	• Leaf diagnosis and soil testing as a guide to crop fertilization	Taiwan
	1995	• Appropriate use of fertilizers*	Taiwan
	1996	• Managing nutrients in intensive vegetable production*	Taiwan
	1997	• Quality control of organic fertilizer	Korea
	1998	• Production and utilization of agricultural chemicals	Japan
	1999	• Micronutrients in crop production	Taiwan
Training Courses	1974	• Use of minor elements for crops	Taiwan
	1987	• Soil testing and plant analysis	Korea
	1995	• Microbial fertilizers and composting*	Korea
	1995	• Soil and plant analysis for fertilizer recommendations*	Taiwan
	1995	• Microbial fertilizers and composting*	Korea
	1996	• Microbial fertilizers and composting*	Taiwan
	1996	• Soil testing and plant analysis for the diagnosis of fertilizer recommendations	Philippines
	1997	• Quality control of organic fertilizers	Korea
Lecture Meeting	1972	• Rice cultivation and fertilizer use*	Thailand
Special Project	1990	• Study of how to improve the fertilizer use efficiency of rice farming*	Taiwan
Surveys	1973	• Regional fertilizer situation	9 Asian countries
	1983	• Regional fertilizer situation	

* Listed under more than one subject heading

Slopeland development

In slopeland areas of the humid tropics, once the forest vegetation is removed for farming, soil erosion and loss of soil productivity tend to follow within a short time. Asia now has 60 million hectares of deforested uplands where the soils are nutritionally poor and where most farm families have low incomes. The Center was one of the first Asian agricultural agencies to focus on the problems of agriculture on slopelands. It has held many programs on low-cost methods of soil and water conservation, and on profitable and sustainable cropping systems for slopeland areas.

Seminars and Workshops	1977	• Hilly land development	Philippines
	1983	• The development of rainfed agriculture*	Philippines
	1983	• Ecology and management of problem soils in Asia*	Thailand
	1989	• Conservation farming on hillslopes*	Taiwan
	1992	• The Eleventh Technical Advisory Committee Meeting on Sustainable agriculture for the Asian and Pacific Region*	Korea
	1994	• The development of slopeland agriculture	Japan
	1994	• Upland farming systems and the role of livestock production*	Thailand
	1995	• Soil conservation management for sustainable slopeland farming*	Taiwan
	1997	• Sustainable farming systems in upland areas*	Japan
	1997	• Integrated management of slopeland orchards*	Taiwan
	1998	• Crop-animal integration in slopelands*	Vietnam
	1999	• Slopeland use capability	Philippines
	2000	• The management of agricultural resources	Taiwan
Training Courses	1975	• Hilly land development and soil conservation	Taiwan
	1976	• Hilly land development in Taiwan	Taiwan
	1979	• Conservation and utilization of slopeland	Taiwan
	1997	• Hillyland crop-animal integration*	Philippines

Rice

Rice is Asia's most important crop. During the Center's early years, at a time of general food shortages in Asia, its programs were concerned with maximizing rice yields by the use of improved varieties and chemical fertilizers. In later years, as the threat of famine receded and many Asian countries achieved a rice surplus, the Center's programs focused on the more intensive use of paddy fields and greater diversification by the production of off-season crops.

Seminars and Workshops	1974	• The utilization of cereal crop residues*	Japan
	1975	• Maintaining rice production in the face of a shortage of chemical fertilizer*	Taiwan
	1976	• The fertility of paddy soils and fertilizer applications for rice*	Taiwan
	1978	• Fertilizer management for rice*	Taiwan
	1979	• Joint rice farming*	Japan
	1981	• Pest management of rice in East Asia*	Korea
	1987	• The impact of chemical fertilizer marketing and operation systems on rice production*	Korea
	1987	• The diversification of rice utilization*	Thailand
	1988	• The classification and management of rice-growing soils*	Taiwan
	1994	• Sustainable food production in the Asian and Pacific Region*	Taiwan
	1994	• Integrating crop production in lowland rice areas*	Philippines
Lecture Meetings	1972	• Rice cultivation and fertilizer use*	Thailand
	1973	• Rice culture in a cool temperate zone	Korea
Training Courses	1971	• Experimental techniques for rice and other crops	Taiwan
	1988	• Mechanized rice production for small farms*	Taiwan
Special Project	1990	• Study on how to improve the fertilizer use efficiency of rice farming*	Taiwan
Demonstration Project	1993	• Integrating crop production in lowland rice areas*	Philippines

* Listed under more than one subject heading

Upland crops, Multiple cropping

Since its early years, the Center has held many programs to collect and disseminate information on the agricultural techniques which enable farmers to grow three, four or even five different crops each year on the same piece of ground. The Green Revolution in Asia has tended to benefit those on lowland farms, especially those with irrigated farms, more than upland ones. Many of the Center's information programs have been concerned with increasing the incomes of upland farms by improved production, including multiple cropping and new high-value crops, combined with the use of low-cost conservation techniques.

Seminars and Workshops

1975	• Multiple cropping	Taiwan
1977	• Wheat production	Korea
1978	• Production and utilization of cassava*	Thailand
1979	• Corn improvement*	Korea
1979	• Agribusiness systems for integrated crop-livestock-fish farming	Philippines
1980	• Cropping systems – A modern concept	Thailand
1981	• Biological nitrogen fixation and crop production*	Taiwan
1981	• Corn production technology: systems and programs in Asia	Taiwan
1983	• The development of rainfed agriculture*	Philippines
1986	• Yield maximization of feed grains through soil and fertilizer management	Thailand
1986	• Crop simulation models and data base management for agrotechnology transfer*	Taiwan
1986	• Efficient use of water for upland crops	Korea
1987	• Farming systems and management in Asia*	Philippines
1989	• Yield losses due to the continuous cultivation of major economic crops*	Korea
1990	• Integrated technology for field corn production in paddy fields	Philippines
1991	• Increasing nitrogen efficiency in upland crop cultivation*	Korea
1992	• Integrated technology for corn production in paddy field	Philippines
1994	• Integrating crop production in lowland rice areas*	Philippines
1997	• Sustainable farming systems in upland areas*	Japan
1997	• Hillyland crop-animal integration*	Philippines
1998	• Crop-animal integration in slopelands*	Vietnam
2002	• Impacts & biosafety of genetically modified agricultural products	Taiwan

Lecture Meetings

1974	• Crop diversification	Korea
1975	• Production of Irish and sweet potatoes	Korea
1976	• Soybean production	Korea
1980	• Horticultural production under structures	Korea

Training Courses

1971	• Multiple cropping	Taiwan
1972	• Multiple cropping	Taiwan
1973	• Multiple cropping	Taiwan
1974	• Multiple cropping	Taiwan
1975	• Multiple cropping	Taiwan

Demonstration Projects

1971-76	• Multiple cropping	Philippines
1991	• Demonstration project on integrated technology for corn production	Philippines
1993	• Integrating crop production in lowland rice areas*	Philippines

* Listed under more than one subject heading

Horticultural crops

The production of fruit and vegetable production has been growing in the region over the past few decades, as rising incomes have led to a growth in the consumption of high-quality foods. Since the 1980s, the Center has held several programs on horticultural crops. These have involved various aspects of production, including pest control and the use of low-cost plastic rainshelters and greenhouses. Although horticultural crops are high-value, they tend to be highly perishable, and present special marketing problems. Several of the programs have been concerned with efficient marketing systems for horticultural crops produced on small farms in Asia.

Seminars and Workshops	1985	• Plant growth regulators in agriculture	Japan
	1986	• Improvement of vegetable production in Asia	Thailand
	1988	• The utilization of plastics in agriculture	Korea
	1989	• Improvement of vegetable marketing by producers' cooperatives	Korea
	1989	• Off-season production of horticultural crops	Taiwan
	1990	• Hydroponic cultivation of high-value horticultural crops in the tropics	Malaysia
	1991	• Improved vegetable production through the use of fertilizer, mulching and irrigation*	Thailand
	1991	• Cultivation under simple (plastic/greenhouse) structures in the tropics and subtropics	Taiwan
	1996	• Managing nutrients in intensive vegetable production*	Taiwan
	1996	• Citrus production in Asia	Korea
	1997	• Integrated management of slopeland orchards*	Taiwan
	1999	• Protective structures for improved crop production	Taiwan
Lecture meetings	1975	• Production of Irish and sweet potatoes	Taiwan
	1980	• Horticultural production under structures	Korea
Demonstration project	1989-90	• Fertilizers, drip irrigation and mulches for vegetable production	Thailand

Seed production, Plant breeding

Rather than adapt the environment to the crop, it is much cheaper and more efficient to adapt the crop to the environment. Most of the success of the Green Revolution can be attributed to the breeding of improved varieties with higher yields, and more resistance to disease and other stresses. Once improved varieties are developed, it is the system of seed production and distribution which determines whether small-scale farmers are able to make use of them or not. Since the Center's early years, a steady proportion of its programs have been concerned with seed production, distribution of seed to farmers, and the breeding of crop varieties adapted to the economic and environmental conditions of small farms in Asia.

Seminars and Workshops	1973	• Seed production and quality control	Japan
	1979	• Corn improvement*	Korea
	1982	• Tissue culture as a means of plant breeding	Korea
	1984	• Seed production of selected crops in Asian and Pacific countries	Thailand
	1987	• Cell and tissue culture in field crop improvement	Japan
	2001	• Seed and seedling science and technology	Taiwan
Surveys	1997	• Pomelo germplasm in Vietnam	Vietnam
	1997	• Technology for virus-free citrus nursery systems	Malaysia

* Listed under more than one subject heading

Training Courses	1975	• Tropical pasture seed production and technology*	Philippines
	1988	• Tissue culture for plant breeding	Taiwan
	1989	• Regional training workshop in seed technology	Philippines
	1992	• Hybrid seed production and processing of field crops	Taiwan
	1997	• Technology for virus-free citrus nursery systems	Malaysia, Vietnam Taiwan, Thailand, Vietnam
	2002	• Seedling science and technology	Philippines
Special project	2002	• Establishment of national pathogen-free banana & plantain repository in selected Southeast Asian Countries (1st year)	Philippines, Thailand and Vietnam

Postharvest technology

Improving postharvest technology is often a much easier and cheaper way of increasing the amount of consumable food than increasing production. The levels of yields lost after harvest varies according to the crop and the country, but can be as high as 50%, particularly in tropical countries. As well as improved postharvest handling and storage, food processing plays an important role in increasing farm incomes. Food processing adds value to produce, and helps overcome seasonal gluts and shortages. The Center has held a number of programs on small-scale food processing suitable for rural areas, and improved postharvest handling, especially of perishable crops such as fruit and vegetables.

Seminars and Work-shops	1977	• Handling and storage of crops after harvest	Taiwan
	1978	• Food safety	Taiwan
	1979	• Oriental fermented foods	Taiwan
	1984	• Post-harvest technology of agricultural produce	Taiwan
	1984	• Alternative sources of energy for agriculture	Taiwan
	1985	• Food processing by rural families	Philippines
	1987	• The diversification of rice utilization*	Thailand
	1987	• Postharvest handling of tropical and subtropical fruit crops	Taiwan
	1991	• Agribusiness and the role of farmers' organizations*	Korea
	1995	• Small farmers' food processing enterprises	Korea
Survey	1992-3	• Postharvest handling losses of perishable horticultural crops in Asian countries	Philippines, Taiwan, Korea Japan, Thailand

Plant protection

In the early years of the Green Revolution, chemical treatments were a cheap and effective control for the insect pests, diseases and weeds which damage crops. However, problems soon arose of resistance, so that even heavy chemical applications became ineffective. It was soon realized that dependence on a single measure, whether pesticides or varietal resistance, to protect crops eventually ends in failure because of the problem of resistance. The Center's information programs for pests, diseases and weeds have focused on integrated pest and weed management systems, which combine different control methods in an integrated strategy. Biological control methods have been emphasized, since they tend to be safe, suitable for small farms, and relatively cheap.

Seminars and Workshops	1975	• Rodent control	Japan
	1976	• Control of rice brown planthopper	Japan
	1977	• Plant diseases due to mycoplasma-like organisms	Japan
	1978	• Sensible use of pesticides	Japan
	1980	• Weeds and their control in Asia	Japan

* Listed under more than one subject heading

Seminars and Workshops (cont.)	1981	• Pest management of rice in East Asia*	Korea
	1982	• Pesticide use in developing countries – present and future	Japan
	1983	• Weed control in the Asian and Pacific Region	Korea
	1983	• Soil-borne diseases of crops in Asia	Japan
	1985	• Virus diseases of horticultural crops in the tropics	Taiwan
	1986	• Biological control of pests for field crops	Japan
	1988	• The diseases of crop plants in the tropics	Japan
	1989	• The use of parasitoids and predators to control agricultural pests	Japan
	1990	• Biological control of plant diseases and virus vectors	Japan
	1991	• The biology and control of fruit flies	Japan
	1991	• Migration and dispersal of agricultural insect pests	Japan
	1992	• Biological control and integrated management of paddy and aquatic weeds in Asia	Japan
	1993	• Management of insect-borne virus diseases in temperate and subtropical Asia	Korea
	1993	• Use of biological control agents under integrated pest management	Japan
	1995	• Management of insect borne fruit tree diseases in the Asian and Pacific Region	Thailand
	1995	• Integrated weed management for sustainable agriculture in the Asian and Pacific Region	Japan
	1998	• The management of disease-free orchards in the tropics	Philippines,Malaysia
	2000	• Food safety and quarantine inspection	Korea
	2000	• Sweetpotato production, with special reference to weevils	Japan
	2000	• Establishing protocols for indexing and detecting virus- and virus-like diseases in vegetatively propagated crops	
	2001	• Biological control of insect pests of economic crops	Korea
	2002	• Citrus orchard rehabilitation in tropical Asian countries	Vietnam
	2002	• Impacts & biosafety of genetically modified agricultural products	Taiwan
Lecture meeting	1979	• Rice blast disease	Korea, Malaysia
Training Courses	1992	• Forecasting of occurrence of insect-borne virus diseases in paddy and soybean fields	Indonesia
	1993	• Rapid bioassay of pesticide residues on fruit and vegetables	Taiwan
	1995	• Rapid bioassay of pesticide residues on crops	Philippines
	1996	• Plant quarantine	Guam, Fiji
	1997	• Biological control of pests and weeds	Australia
	1997	• Weed management in tropical Asia	Thailand
	1999	• Rapid bioassay of pesticide residues	Korea
	1999	• Appropriate pesticide use	Taiwan
Surveys	1988	• Virus and virus-like diseases of citrus	Japan, Korea Philippines, Thailand
	1989	• Greening (Huanglunpin) and citrus virus disease	Indonesia
	1992	• Plant virus diseases and their vectors	Vietnam
	1993	• Natural enemies of virus vectors and mild strains of virus for economically important crops in the tropics	
	1994	• Virus diseases of fruit trees in the Pacific Island nations	
	1996-97	• Production and utilization of agricultural chemicals in Asian countries	Fiji, India, Japan, Korea, Malaysia, Nepal, Philippines, Taiwan ROC, Sri Lanka
	1997	• Disease incidence and nursery systems for disease-free seedlings	Malaysia, Thailand, Vietnam

* Listed under more than one subject heading

Special Projects	1990-96	• Control of virus diseases of crops in the Asian and Pacific Region	12 countries
	1991	• Survey of natural enemies of virus vectors for economically important crops in the tropic	Taiwan, Malaysia, Indonesia,
	1999	• Mechanized production of *Trichogramma*	Philippines, Taiwan
	1999	• Demonstration orchard	Vietnam
	1999	• Rapid indexing and elimination of virus diseases of vegetatively propagated crops	Indonesia, Taiwan, Korea
	2000	• Establishing protocols for indexing and detecting virus- and virus-like diseases in vegetatively propagated crops	Vietnam
	2000	• Field demonstration: The management of a virus-free nursery system for citrus	Vietnam
	2001	• Management of a citrus virus-free nursery system	Vietnam
	2002	• Application of molecular diagnostic probes for viruses of banana and citrus	Malaysia, Philippines Indonesia, Thailand, Vietnam

Agricultural development, Extension

The cutting edge of agricultural improvement programs is found on farms, where farmers will decide whether to accept or reject recommendations on new technology. This is the realm of agricultural extension. The success or failure of technical development programs often depends as much on the quality of the extension support as on the technology itself. A large number of the Center's information programs, especially during its early years, were designed to support and strengthen the region's national extension services. Programs included not only extension techniques, but the training of extension workers and the organization of extension services. In recent years, the Center has developed its use of information technology.

Seminars and Workshops	1976	• The role of farm planning and management analysis in agricultural extension*	Taiwan
	1978	• Technology generation, verification and dissemination	Philippines
	1978	• Farm business management*	Korea
	1980	• Support communication for rural development programs	Philippines
	1982	• Extension curriculum development	Philippines
	1985	• Applied agricultural research and development for small farms*	Philippines
	1986	• Crop simulation models and data base management for agrotechnology transfer*	Taiwan
	1992	• Strengthening of marketing extension services for small-scale farmers*	Korea
	1993	• Recent trends and future prospects of rice farming in Asia	Korea
	1996	• Integrated management of agricultural information (13th Technical Advisory Committee Meeting)	Japan
Training Course	1970	• Extension techniques	Taiwan
Survey	1993	• National agricultural extension systems, with a focus on livestockand poultry	Philippines, Thailand, Indonesia,Malaysia, Korea, Japan, Taiwan
	1999	• Information flow in extension systems and information needs of extension workers	Philippines, Vietnam, West Samoa
	2000	• Flow of agricultural information in national extension systems	8 countries
Special Projects	1999	• FFTC/IBSRAM joint database project	Taiwan and Thailand
	2000	• On-line database of technology for sustainable land management	

* Listed under more than one subject heading

Marketing, farm machinery, cooperatives

An important constraint in the development of Asian agriculture is the small average size of farms, sometimes less than one hectare (2.47 acres). This presents problems in mechanizing farm operations. It is also difficult to develop an efficient marketing system for large numbers of small, diverse shipments from many thousands of farms. An important way of achieving economies of scale in marketing, farm mechanization and many other aspects of production is for farmers to organize into agricultural cooperatives. A number of the Center's programs have analyzed the major constraints facing farmers' cooperatives, and how these can be overcome.

Seminars and Workshops

1976	• The role of farm planning and management analysis in agricultural extension*	Taiwan
1977	• Managerial aspects of farmers cooperatives	Taiwan
1978	• Farm mechanization for small farms	Taiwan
1978	• Farm business management	Korea
1979	• Joint rice farming*	Japan
1979	• Institutional improvements in agricultural marketing	Taiwan
1980	• Cooperative agricultural credit in the Asian and Pacific Region*	Taiwan
1980	• Towards efficient food marketing systems in Asian economies	Korea
1983	• Producer-oriented marketing: strategies and programs	Korea
1984	• The role of agricultural cooperatives in integrated rural development	Korea
1984	• The efficient farm mechanization of small farms	Korea
1986	• Social and economic aspects of farm mechanization	Korea
1987	• The impact of chemical fertilizer marketing and operation systems on rice production*	Korea
1988	• The management of cooperative agricultural marketing	Thailand
1989	• Improvement of vegetable marketing by producers' cooperatives	Korea
1990	• Liberalization of the trade in agricultural products and the protection of farmers' interests	Korea
1991	• Integrated systems of swine production, extension and marketing*	Thailand
1991	• Enlarging the scale of farm operations of smallholders*	Thailand
1992	• Strengthening of marketing extension services for small-scale farmers*	Korea
1994	• Agricultural marketing information systems in Asian	Korea, Taiwan
2002	• Improvement of agricultural marketing under trade liberalization	Korea

Lecture Meeting Training Courses

1977	• Mechanization of small farms	Korea
1973	• Farmer's organizations and food production	Taiwan
1988	• Mechanized rice production for small farms	Taiwan

Agricultural economics

Agriculture can be sustainable only if it is also profitable. Economics have been an important aspect of the Center's programs since its early years, at both a farm and a regional level. Early programs included discussion of farm management, land tenure systems and credit for small farms in Asia. There were also a number of programs which looked at the general economic situation in the Asian and Pacific region as it affected small farms, particularly the food situation, and the levels of supply and demand for agricultural crops and livestock products.

Seminars and Workshops

1972	• Economics of fertilizer use* (1)	Taiwan
1972	• Economics of fertilizer use* (2)	Thailand
1974	• Future pattern of fertilizer demand and supply in ASPAC countries*	Taiwan
1976	• The role of farm planning and management analysis in agricultural extension*	Taiwan
1978	• Farm business management*	Korea
1980	• Cooperative agricultural credit in the Asian and Pacific Region*	Taiwan
1980	• Food situation and potential in the ASPAC Region	Taiwan

* Listed under more than one subject heading

	1981	• Off-farm employment and rural industrialization	Japan
	1982	• Adjustment of small farm development and land tenure systems in Asia	Taiwan
	1984	• The efficient farm mechanization of small farms	Korea
	1984	• Alternative sources of energy for agriculture	Taiwan
	1985	• Applied agricultural research and development for small farms*	Philippines
	1985	• Adjustment of national agricultural development programs to meet future needs (15th Anniversary of FFTC)	Taiwan
	1986	• Social and economic aspects of farm mechanization	Korea
	1987	• Farming systems and management in Asia*	Philippines
	1988	• The improvement of financing systems for small farm management	Korea
	1991	• Enlarging the scale of farm operations of smallholders*	Thailand
	1994	• Sustainable food production in the Asian and Pacific Region*	Taiwan
	1996	• Food production and the economic sustainability of family farms in an open market situation	Korea
	1998	• Asian agriculture in the 21st century	Taiwan
	1998	• Rural tourism	Korea
	2001	• Integration of agricultural and environmental policie in an environmental age	Korea
	2001	• Multifunction of agriculture	Japan
Surveys	1995	• Low-cost indigenous farming technology for citrus	6 Asian countries
	1996	• Low-cost indigenous farming technology for corn	7 Asian countries

Livestock feed

Livestock production is becoming increasingly important in Asia, and is the main source of income for many thousands of farmers. Many of the Center's programs since 1970 have focused on improved livestock production, as a source both of protein foods for the farm family and of cash income. Since most feed grains used in the Asian livestock industry are imported, the price of livestock feed is a major constraint. Many programs have focused on the use of alternative feed resources such as urea treated rice straw, and the production of feed crops as an intercrop in both paddy and upland fields.

Seminars and Workshops	1972	• Production and evaluation of forage and fodder crops	Thailand
	1976	• Ruminant nutrition	Korea
	1978	• Production and utilization of cassava*	Thailand
	1978	• Backyard dairy-beef farming and feedgrain substitutes*	Korea
	1982	• Feeding standards for livestock and poultry	Korea
	1983	• Recent advances in pasture research and development in Southeast Asia	Thailand
	1986	• Yield maximization of feed grains through soil and fertilizer management	Thailand
	1989	• Feed grain substitutes and non-conventional feedstuffs for livestock and poultry in Asia	Philippines
	1989	• Conventional feedstuffs for livestock and poultry in Asia	
	1994	• Development approaches for livestock-based rural enterprises	Philippines
	1994	• Upland farming systems and the role of livestock production*	Thailand
Training Course Lecture Meetings	1995	• Indigenous feed resources for sustainable animal productivity	Philippines
	1972	• Grassland farming	Japan
	1973	• Pasture production under coconut palms	Philippines
	1975	• Tropical pasture seed production and technology*	Philippines
	1976	• Ranch management and development*	Philippines
Study tour	1973	• Some aspects of grassland farming	Vietnam
	1974	• The production of quality pasture and fodder crops in Taiwan ROC, Philippines, Vietnam, Thailand	Taiwan, Philippines, Thailand, Vietnam
	1987	• Buffalo study tour	Taiwan

* Listed under more than one subject heading

Livestock and poultry production

In the Center's early years, most livestock in Asia were kept on mixed crop/livestock farms. Production of large animals such as cattle and water buffalo was primarily for draft. Many of the Center's early programs emphasized integrated crop/livestock production, based on the recycling of crop residues as feed, and livestock wastes as fertilizer. This pattern is still very relevant for low-income farmers in slopeland areas, but nowadays many lowland livestock farms in Asia are specialized commercial enterprises. FFTC programs have focused on efficient dairy, beef, pig and poultry production on small farms in Asia. Low-cost disease control methods, particularly preventative methods such as efficient vaccination programs and quarantine procedures, have been emphasized.

Seminars and Workshops	1975	• The Asiatic water buffalo	Thailand
	1977	• Swine production on small farms	Taiwan
	1978	• Backyard dairy-beef farming and feedgrain substitutes*	Korea
	1979	• Increasing buffalo production for small farms	Thailand
	1979	• Agribusiness systems for integrated crop-livestock-fish farming	Philippines
	1980	• Quarantine and control of infectious diseases in domestic animal	Taiwan
	1981	• Animal health problems in the Asian and Pacific Region	Korea
	1981	• Recent advances in buffalo research and development in Asia	Thailand
	1982	• Inland and coastal aquaculture	Thailand
	1982	• Feeding standards for livestock and poultry	Korea
	1982	• Research and control of poultry diseases in Asia	Taiwan
	1983	• Impact of artificial insemination on livestock production in Southeast Asia	Philippines
	1984	• Recent improvements in goat production in Asia	Philippines
	1985	• Dairy and dairy-beef production in tropical Asia	Thailand
	1986	• Prospects and problems of Asian water buffalo development	Philippines
	1987	• Pig breeding and development in Asia	Taiwan
	1988	• The utilization of livestock and poultry manure*	Philippines
	1989	• Poultry breed or genotype evaluation in village or field populations	Taiwan
	1991	• Integrated systems of swine production extension and marketing*	Thailand
	1991	• Animal disease prevention and control in Asia	Taiwan
	1992	• Prevention and control of poultry diseases	Thailand
	1996	• Sustainable crop-animal integration in different ecosystems in the Asian and Pacific Region	Philippines
	1998	• Crop-animal integration in slopelands*	Vietnam
Lecture Meetings	1973	• Some aspects of beef production	Taiwan, Thailand
	1975	• The Asian beef industry	Taiwan
Study tour	1987	• Buffalo study tour	Taiwan
	1993	• Study tour of Taiwan dairy industry	Taiwan
Training courses	1976	• Ranch management and development*	Taiwan
	1988	• Pregnancy diagnosis and artificial insemination for water buffalo	Taiwan
	1990	• Mule duck production	Taiwan
	1997	• Hillyland crop-animal integration*	Philippines
	2000	• The use of reproductive biotechniques for cattle and water buffaloes	Philippines
	2001	• Slaughtering and processing of livestock	Taiwan
	2002	• Reducing heat stress in dairy cattle	Taiwan
Surveys	1996	• Low-cost indigenous farming technology for livestock	Korea, Philippines,
	1999	• Applied biotechnology in animal production	Japan, Korea, Philippines, Thailand, Taiwan
Special project	1990	• Cataloguing of indigenous/native poultry breeds and genotypes in Asia	6 Asian countries

* Listed under more than one subject heading

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